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THE BORNEAN GASTROMYZONTINE FISH
GENERA *GASTROMYZON* AND *GLANIOPSIS*
(CYPRINIFORMES, HOMALOPTERIDAE),
WITH DESCRIPTIONS OF NEW SPECIES

By

Tyson R. Roberts

California Academy of Sciences, Golden Gate Park,
San Francisco, California 94118

ABSTRACT: The endemic Bornean gastromyzontine genera *Gastromyzon* and *Glanopsis* are revised. *Neogastromyzon* is shown to be generically distinct from *Gastromyzon*. *Gastromyzon monticola*, formerly placed in the synonymy of *Gastromyzon borneensis*, is a valid species. Five new species of *Gastromyzon* (*G. contractus*, *G. ctenocephalus*, *G. lepidogaster*, *G. megalepis*, and *G. ridens*) and three new species of *Glanopsis* (*G. denudata*, *G. gossei*, and *G. multiradiata*) are described, bringing the total known species in these genera to nine and four, all of which are illustrated photographically.

INTRODUCTION

Gastromyzontinae are bottom-dwelling fishes of swift-flowing highland and lowland streams in China, Vietnam, and Borneo. Most of the approximately 15 genera and 52 species are highly specialized, with ventrally flattened head and body; inferior mouth frequently with numerous barbels or papillae; head, body, and fins heavily tuberculate; and paired fins modified. Several genera have greatly enlarged pectoral and pelvic fins with more numerous rays than in any other Cypriniformes, and the pelvic fins may be united posteriorly, a condition otherwise unknown in the Ostariophysi. A synopsis of all Gastromyzontinae is given by Silas (1953); Chinese forms are reviewed and new species described by Chen (1980).

I collected samples of Gastromyzontinae during an ichthyological survey of the Kapuas River basin, western Borneo, in 1976. Work on their

identification led to the present revision of *Gastromyzon* and *Glanopsis*. Borneo is inhabited by five or six gastromyzontine genera: *Gastromyzon* Günther, 1874; *Glanopsis* Boulenger, 1899; *Neogastromyzon* Popta, 1905; *Parhomaloptera* Vaillant, 1902; *Progastromyzon* Hora and Jayaram, 1951a, and *Protomyzon* Hora, 1932. I have studied only the first three of these genera. *Neogastromyzon* was placed in the synonymy of *Gastromyzon* by Inger and Chin (1961) but is shown here to be a valid genus. *Progastromyzon* was placed in the synonymy of *Protomyzon* by Inger and Chin (1962). All of these genera, with the possible exception of *Protomyzon*, seem to be endemic to Borneo. Two new species of *Protomyzon* are described from China by Chen (1980); otherwise *Protomyzon* is also known only from Borneo.

Gastromyzon was revised by Inger and Chin (1962). They described two new species refera-

ble to *Gastromyzon*, but misidentified *G. borneensis*, the generic type-species, and omitted *G. monticola*, previously placed in the synonymy of *G. borneensis* but here shown to be a distinct species. Five new species of *Gastromyzon* are described in this paper, bringing the total number of described species to nine, four of which occur in the Kapuas basin. *Glaniopsis*, hitherto considered monotypic (Weber and de Beaufort 1916; Inger and Chin 1962), is known only from northern Borneo; three new species of *Glaniopsis* are described, and additional material is reported but not named which may represent additional species.

Apart from systematics little has been published about *Gastromyzontinae*. Osteology and classification of some genera, including *Gastromyzon* and *Glaniopsis*, are treated by Ramaswami (1948, 1952); classification of *Glaniopsis* is discussed also by Hora and Jayaram (1951b). Wickler (1971) described locomotion, feeding, and territorial behavior in *Gastromyzon*; the species he studied is probably *G. fasciatus* (and not *G. borneensis*). Reproductive behavior has not been studied.

MATERIAL AND METHODS

This paper is based on material deposited in the following institutions: British Museum (Natural History) (BMNH); California Academy of Sciences (CAS), including material formerly deposited in the Natural History Museum, Stanford University (SU); Field Museum of Natural History, Chicago (FMNH); Institut Royal des Sciences Naturelles de Belgique (IRSNB); Museum of Comparative Zoology, Harvard (MCZ); Muséum National d'Histoire Naturelle, Paris (MNHN); Museum of Zoology, Bogor, Indonesia (MZB); Rijksmuseum van Natuurlijke Historie, Leiden (RMNH); and Zoological Museum, University of Amsterdam (ZMA).

Specimen lengths are standard length and proportional measurements are expressed as times in standard length, unless indicated otherwise. Eye diameter is the greatest horizontal or nearly horizontal measurement of the exposed portion of the eyeball. Interorbital width is the measurement between the exposed portion of the eyeballs. Mental barbels are referred to as "flap-like" rather than "barbel-like" if the length of their base is greater than their height (in some species of *Glaniopsis*). "Lateral scale series"

refers to the scale row bearing tubes or pores for the lateral line sensory canal. Observation of scales in *Glaniopsis* was facilitated by staining some specimens superficially with alizarin. "Principal caudal-fin rays" includes all branched principal caudal rays plus one upper and one lower simple principal ray.

The following anatomical features or characters found in *Gastromyzontinae* have not been named previously, are relatively unfamiliar, or otherwise require comment:

Adhesive pads—pads of thickened, depigmented skin on ventral surface of anteriormost pectoral- and pelvic-fin rays: in many rheophilic, bottom-dwelling cyprinoids, probably including all *Gastromyzontinae*. The pads apparently increase the frictional properties of the paired fins in contact with substrate; in *Gastromyzon contractus* they are covered with horny, hook-shaped, posteriorly directed projections arising from single epidermal cells (Roberts, in press).

Ctenoid tubercles—tubercles forming minute, comblike projections on dorsolateral portions of head: first reported by Inger and Chin (1962) as "numerous short, curved rows of sensory papillae" on male *Neogastromyzon pauciradiatus*; I also found them on male *Gastromyzon ctenocephalus*. In both species I observed that areas with finely ctenoid tubercles grade into areas with more and more coarsely ctenoid tubercles and finally into quite ordinary-looking small conical tubercles.

Gill opening angular—gill opening lying posterior to opercle and extending anteriorly a short distance ventral to subopercle, so that free margin of gill cover is angular: in some *Gastromyzon*.

Gill opening vertical—gill opening lying entirely posterior to opercle, so that free margin of gill cover is vertical or nearly so: in some *Gastromyzon*.

Horny jaw sheaths—more or less thick sheaths of horny skin, sometimes forming a sharp "cutting edge," on upper and lower jaws: in many cyprinoids, probably including all *Gastromyzontinae*.

Lateral oral fold—a flap of skin with discrete margins, extending from rostral cap to pectoral-fin origin lateral to corner of mouth: in *Gastromyzon* only (Fig. 1b).

Postoral pouch—an anteriorly open, transverse pocket or pouch on ventral surface of head

immediately posterior to mouth, formed by a fleshy transverse fold or "postoral flap": in *Gastromyzon borneensis*, *G. monticola*, and *Neogastromyzon nieuwenhuisi* (Fig. 1). *Gastromyzon fasciatus* sometimes has a weakly developed postoral flap without formation of a postoral pouch.

Rostral cap—a fold or cap of skin, usually horny, with a more or less pronounced ventral groove, overlying upper lip: in nearly all cyprinoids, probably in all Gastromyzontinae (Fig. 1). Sometimes misidentified as upper lip.

Secondary rostrum—a discrete projection at snout tip, supported internally by anteriorly directed, flangelike projections of the lacrimal bones, and heavily tuberculate in large adults: in *Gastromyzon borneensis* but no other Gastromyzontinae (Fig. 1a, b); superficially similar projections, possibly involving the lacrimal bones, occur in some Garriinae and Labeoinae.

Serrae—posteriorly or dorsoposteriorly directed bony projections, arising from individual lepidotrichia, usually strongly developed on pelvic fin, sometimes also present but weakly developed on pectoral fin: in all *Gastromyzon* except *G. megalepis*; morphologically similar and perhaps functionally analogous projections occur mainly on the anal fin but sometimes also on the pelvic and other fins in many Neotropical Characidae, but they have not been reported previously in any cyprinoids.

Sublacrimal groove—a more or less deep fold or groove between lacrimal bone and rostral cap: in *Gastromyzon* only (Fig. 1a, b).

Subopercular groove—groove extending from lower corner of gill opening to pectoral-fin origin, sometimes discontinuous or interrupted near its middle: in several *Gastromyzon*, possibly in other Gastromyzontinae with restricted gill opening.

Suprapelvic flap—a fleshy flap of skin immediately dorsal to anteriormost portion of pelvic fin: in many Gastromyzontinae; in *Gastromyzon* and *Neogastromyzon* the suprapelvic flap is continuous anteriorly with a flat lateral extension of the body wall which forms the ventrolateral margin of the abdomen.

Tubercles—multicellular horny tubercles of epidermal origin (frequently referred to as "nuptial tubercles," "breeding tubercles," or "pearl organs" in the literature) occur on the head, body, and fins of many cyprinoids including all

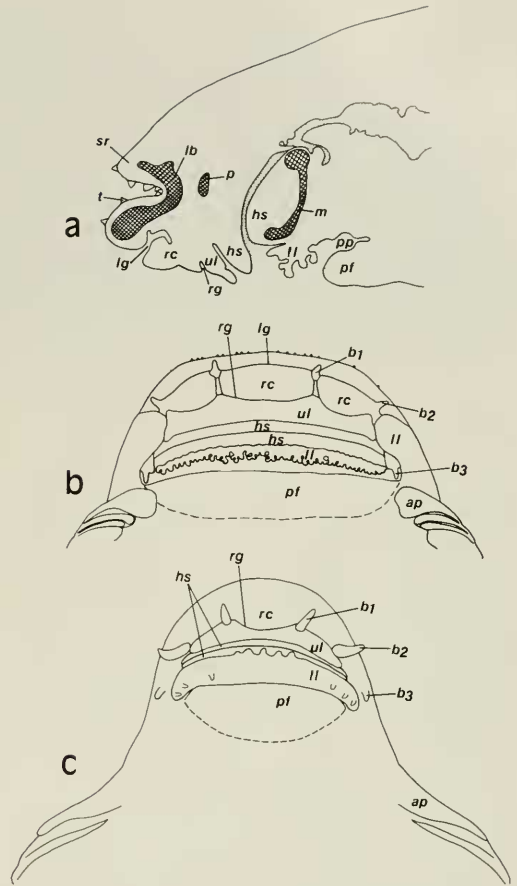


FIGURE 1. (a) *Gastromyzon borneensis*, sagittal section of head; (b) *Gastromyzon borneensis*, ventral surface of head; (c) *Neogastromyzon nieuwenhuisi*, ventral surface of head. (ap = adhesive pad; b₁, b₂, b₃ = rostral, maxillary, mandibular barbels; hs = horny sheaths of upper and lower jaws; lb, lg = lacrimal bone, sublacrimal groove; lf = lateral oral fold; ll, ul = lower and upper lips; m = mandible; pf, pp = postoral fold, postoral pouch; rc, rg = rostral cap, rostral groove; sr = secondary rostrum; t = tubercle; stippling = alimentary canal.)

Gastromyzontinae. They vary in size from the relatively large ones on the secondary rostrum and side of the body in male *Gastromyzon borneensis* (Fig. 5) to minute ones, barely visible with a dissecting microscope, such as those found in dense patches on the dorsal surface of the pectoral-fin rays in males of several species of *Gastromyzon*, including *G. contractus* (Fig. 2), or the very fine pricklike tubercles widely scattered on the head and body of *Glanioptis*.

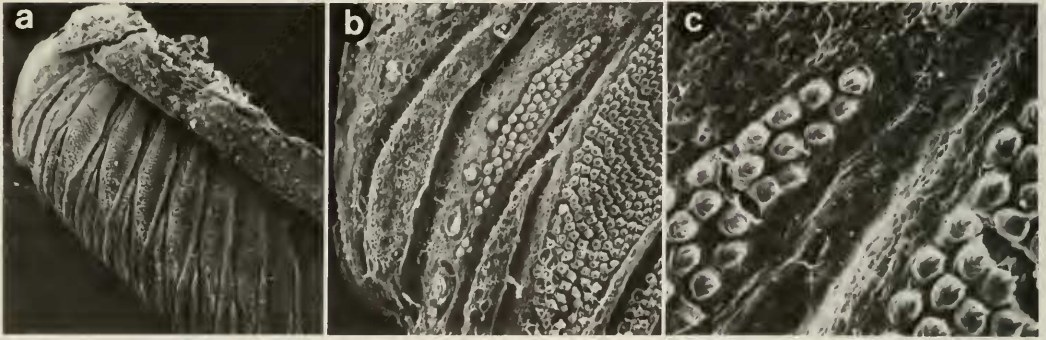


FIGURE 2. Dense patches of small, conical tubercles on dorsal surface of anteriormost pectoral-fin rays, *Gastromyzon contractus*, 32.2-mm male paratype (CAS 44186). Horizontal field width = 4.2 mm (a), 1.1 mm (b), and 330 μm (c).

No direct observations have been made concerning their function in Gastromyzontinae, so a term which does not imply a known function is preferred. Tubercles exhibit striking sexual dimorphism in Gastromyzontinae, as in many other groups of Cypriniformes, but they are also present in immature specimens of both sexes and presumably function in various modes of behavior.

KEY TO BORNEAN GENERA OF GASTROMYZONTINAE

- 1a. Pelvic fins united posteriorly, each with 14–24 branched rays; suprapelvic flap present, continuous anteriorly with lateral extension of body wall which forms ventrolateral abdominal margin 2
- 1b. Pelvic fins separate, each with 7–11 branched rays; suprapelvic flap present or absent 3
- 2a. Sublacrimar groove present; rostral and maxillary barbels project from anterior margin of rostral cap (Fig. 1b); head width at most 4; adhesive pad of anteriormost pectoral-fin ray with anterior margin free from abdomen; dorsal surface of pelvic fin usually serrate *Gastromyzon*
- 2b. Sublacrimar groove absent; rostral and maxillary barbels project from posterior margin of rostral cap; head width at least 5; adhesive pad of anteriormost pectoral-fin ray with anterior margin continuous with skin of abdomen; dorsal surface of pelvic fin not serrate *Neogastromyzon*
- 3a. Mouth subterminal; nasal barbels pres-

- ent; two mandibular barbels near each corner of mouth (Fig. 15); suprapelvic flap absent *Glanioptis*
- 3b. Mouth inferior; nasal barbels absent; a single mandibular barbel near each corner of mouth; suprapelvic flap absent? or present 4
- 4a. Gill opening extends ventrally onto ventral surface of body anterior to pectoral fin; branched pectoral-fin rays 16–18; suprapelvic flap absent? *Parhomaloptera*
- 4b. Gill opening extends ventrally to base of pectoral fin, not onto ventral surface of body; branched pectoral-fin rays 18–24; suprapelvic flap present but not continued anteriorly to pelvic fin *Protomyzon*

Gastromyzon Günther

Gastromyzon GÜNTHER, 1874:454 (type-species *Gastromyzon borneensis* Günther, 1874, by monotypy).

Lepidoglanis VAILLANT, 1889:81 (type-species *Lepidoglanis monticola* Vaillant, 1889, by monotypy).

DIAGNOSIS.—*Gastromyzon* differs from all other Gastromyzontinae including *Neogastromyzon* in having a sublacrimar groove between lacrimal bone and rostral cap; rostral and maxillary barbels projecting from anterior (rather than from posterior) margin of rostral cap; a lateral oral fold; and lepidotrichia of pelvic-fin rays (and to a lesser extent, of pectoral-fin rays) bearing serrae (present in all but one species of *Gastromyzon*; absent in *Neogastromyzon* and not reported or observed in any other Gastromyzontinae).

Pectoral, pelvic, and anal fins close-set or

even overlapping. Pectoral fin with 1 simple and 22–30 branched rays, its origin underneath head on or near a level with anterior margin of eye. Adhesive pads present on about 10–12 anteriormost pectoral-fin and 8–10 anteriormost pelvic-fin rays. Adhesive pad of first (unbranched) pectoral-fin ray with anterior margin free from abdomen (continuous with skin of abdomen in *Neogastromyzon*). Pelvic fins united posteriorly, each with 1 simple and 17–24 branched rays. Suprapelvic flap large, continuous anteriorly with lateral extension of body wall forming ventrolateral abdominal margin (as in *Neogastromyzon* but no other *Gastromyzontinae*). Dorsal fin with 2 simple and 7–9½ branched rays. Anal fin with 2 simple and 4–5½ branched rays. Principal caudal-fin rays usually 9+8.

Head and abdomen flattened ventrally. Mouth inferior, transverse, very broad. Nasal barbels absent; rostral and maxillary barbels small; mandibular barbels rudimentary or absent. Upper and lower jaws with broad, straight-edged horny jaw sheaths. Lower lip densely papillose except in *G. ctenocephalus* (sparsely papillose in *Neogastromyzon*). Gill opening restricted, lying well above base of pectoral fin (as in *Neogastromyzon* but no other Bornean *Gastromyzontinae*). Postoral pouch, if present, with postoral flap originating at base of first pectoral-fin ray (postoral pouch originates far anterior to pectoral-fin origin in *Neogastromyzon nieuwenhuisi*, the only other *gastromyzontine* with a postoral pouch). Specimens over 30 mm of both sexes usually tuberculate, males generally more so than females. Tuberculation heaviest on snout, dorsal surface of pectoral fin (absent or weakly developed on dorsal, anal, and caudal fins), and sometimes side of body.

GEOGRAPHICAL DISTRIBUTION.—Geographical distribution of *Gastromyzon*, based on material examined in this study, is illustrated in Figure 3. The most widely distributed species, *G. fasciatus* and *G. lepidogaster*, occur in northern, western, and eastern Borneo. *Gastromyzon borneensis*, previously reported from eastern and western Borneo (Weber and de Beaufort 1916; Inger and Chin 1961) apparently is restricted to northern Borneo (Sarawak and North Borneo). Absence of *Gastromyzon* in southern Borneo may be an artifact due to lack of collecting; much of this region, particularly the headwaters, is ichthyologically unexplored.

Key to *Gastromyzon*

- 1a. Secondary rostrum present .. *G. borneensis*
- 1b. No secondary rostrum 2
- 2a. Sublacrima groove extending onto side of head *G. ridens*
- 2b. Sublacrima groove confined to ventral surface of head 3
- 3a. Subopercular groove absent 4
- 3b. Subopercular groove present 6
- 4a. Postoral pouch present *G. monticola*
- 4b. Postoral pouch absent 5
- 5a. Scales in lateral series 54–62; scale rows above lateral series 16–20; specimens over 40 mm with abdomen partly or entirely covered with fine scales
..... *G. lepidogaster*
- 5b. Scales in lateral series 44–48; scale rows above lateral series 11–12; abdomen scaleless except some specimens with a few relatively large scales between posteriormost pelvic-fin rays .. *G. megalepsis*
- 6a. Snout relatively truncate in larger specimens; dorsal surface of head and body with relatively large, round, pale spots (vermiculate spots on head in small specimens); pectoral fin with thin pale band at margin; male without dense patches of small tubercles on dorsal surface of pectoral fin *G. punctulatus*
- 6b. Snout rounded; dorsal surface of head and body without spots or with very small round spots; pectoral fin without thin pale band at margin; male with dense patches of small tubercles on dorsal surface of pectoral fin 7
- 7a. Adpressed dorsal fin extending posteriorly to or beyond level of anal-fin origin; pelvic fin reaching to or beyond anal-fin origin; snout sloping downward in front of eyes relatively strongly *G. contractus*
- 7b. Adpressed dorsal fin falling short of level of anal-fin origin; pelvic fin falling short of or just reaching anal-fin origin; snout sloping downward in front of eyes relatively gently 8
- 8a. Predorsal scales 40–55; branched dorsal-fin rays 8½; branched anal-fin rays 5–5½; male without ctenoid tubercles on head *G. fasciatus*

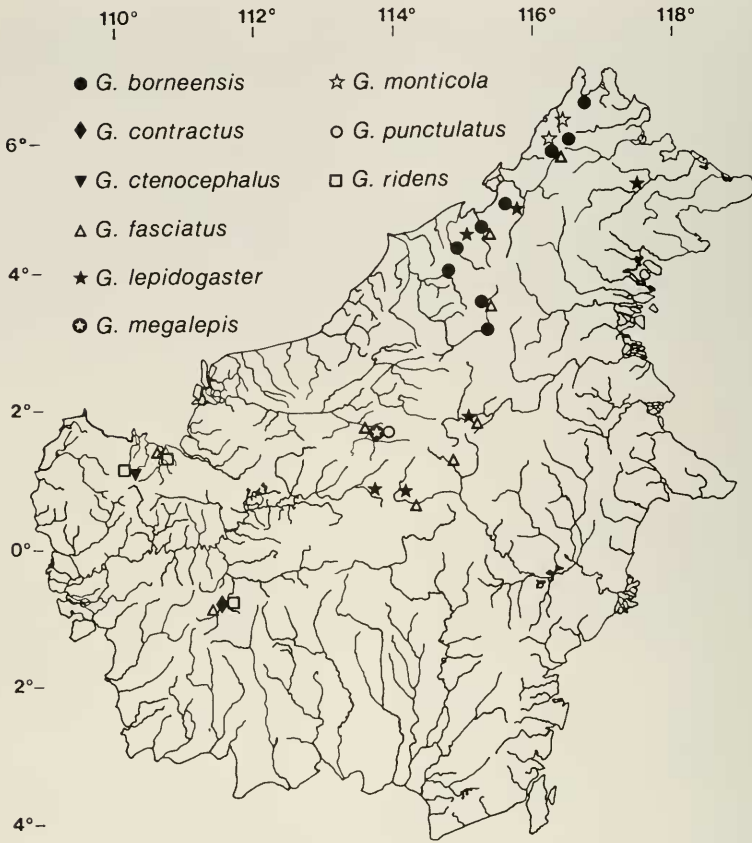


FIGURE 3. Distribution of *Gastromyzon* (based on material examined).

8b. Predorsal scales about 32–36; branched dorsal-fin rays 7½; branched anal-fin rays 4½; male with ctenoid tubercles on head
 ----- *G. ctenocephalus*

***Gastromyzon borneensis* Günther**

(Figures 1a, b, 4–5)

Gastromyzon borneensis GÜNTHER, 1874:6 (type-locality "sources of Mingalong River" = Mengalong River, Beaufort District, North Borneo).

TYPE-MATERIAL.—The type-series of five syntypes (BMNH 1874.11.24:1–5) comprises two species. Four specimens have a prominent secondary rostrum and the abdomen entirely scaleless; they are conspecific. The largest of these (BMNH 1874.11.24:1, 79.1 mm) is hereby designated lectotype of *G. borneensis*; the other three (BMNH 1874.11.24:2–4, 78.3, 72.6, and 65.5 mm) are paralectotypes. The fifth syntype (BMNH 1874.11.24:5, 78.0 mm) lacks a secondary rostrum, has the abdomen entirely covered with fine scales, and is not conspecific with the others; it is now the holotype of *G. lepidogaster* new species.

ADDITIONAL MATERIAL EXAMINED.—NORTH BORNEO: MCZ 34793, 34820, 34823, 27:27.9–70.4 mm, Mount Kinabalu; SU 31473, ZMA 114.365, 6:32.1–52.9 mm, Bongan River, Mandu Bay; FMNH 68129, 4:16.5–38.4 mm, Parutan River, Tambunan; FMNH 68128, 5:20.6–46.5 mm, Sungei Kaingeran, Tambunan. SARAWAK: IRSNB 19723, 64:36.6–89.0 mm, Arur Dalan, a torrential tributary of Padapur River, near Bario, Baram basin; IRSNB 19724, 30:19.7–68.3 mm, Sungai Ramudu, an affluent of Sungai Kalapang, upstream from Paramudu village, Baram basin; BMNH 1978.3.20:232–235, 4:35.4–52.9 mm, Medalam River, Gunong Mulu; BMNH 1895.7.2:82, 1:65.1 mm, Akar River; BMNH 1933.8.9:1–3, 3:57.8–66.9 mm, Lejok River, Tinjar River; FMNH 45852, 1:70.4 mm, Truson River, Lawas; FMNH 45853, 2:64.9–70.5 mm, Pa Brayong, Truson River; FMNH 68583, 3:44.1–51.0 mm, Akah River, Meligong.

DIAGNOSIS.—Attaining 89 mm, and thus possibly the largest species in the genus, *Gastromyzon borneensis* differs from all of its congeners in having a secondary rostrum and, in sexually mature males, developing heavy tuber-

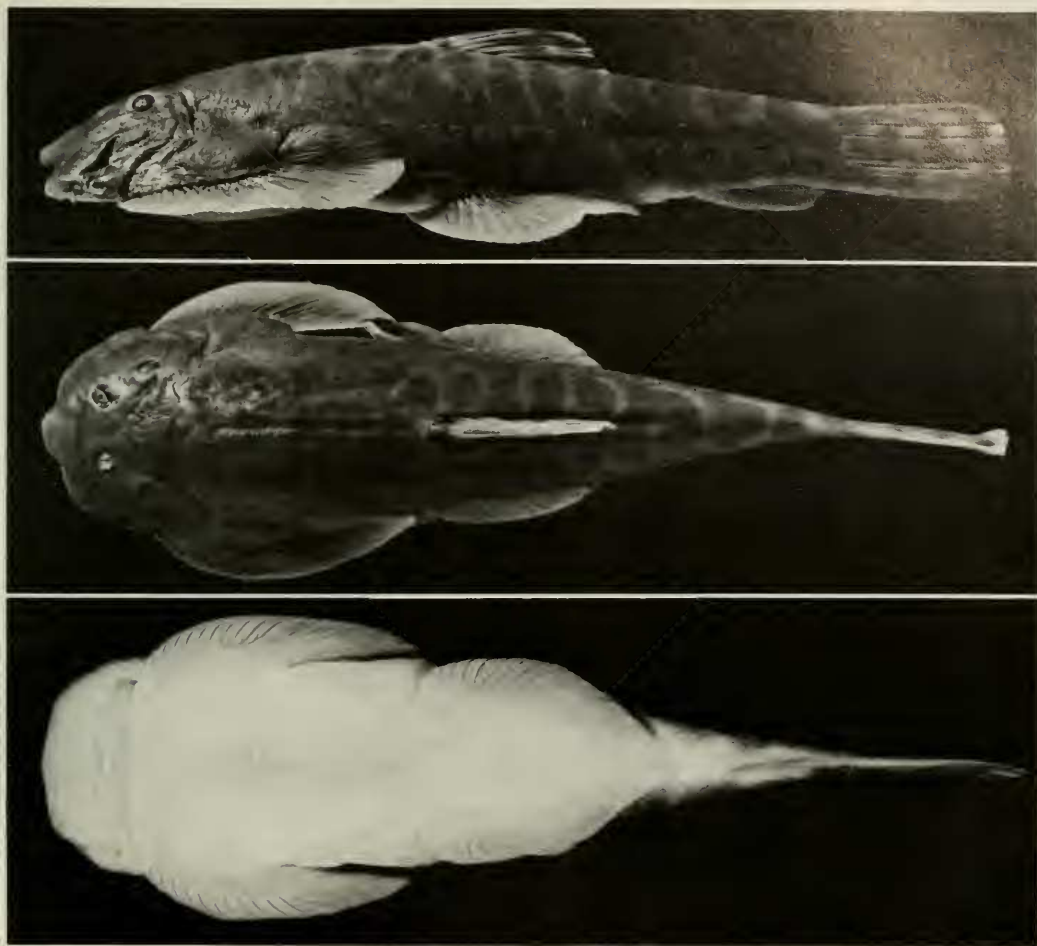


FIGURE 4. *Gastromyzon borneensis*, 88.2-mm female (IRSNB 19723).

culation on posteroventral portion of body. The secondary rostrum, present in all specimens examined over 30 mm of both sexes, is tuberculate in both sexes, but becomes slightly larger and more tuberculate in males than in females. Postoral pouch present (absent in all other *Gastromyzon* except *G. monticola*).

Snout terminating in secondary rostrum, otherwise gently sloping downward in front of eyes and relatively truncate. Gill opening vertical, its length about equal to eye diameter; no subopercular groove. Scales in lateral series 51–62; predorsal scales at least 40; scale rows above lateral series about 20; circumpeduncular scales 28–32. Pectoral fin falls far short of pelvic fin, pelvic fin

short of anal fin, and depressed dorsal fin far short of level of anal-fin origin.

Dorsal and lateral surfaces of body with dull brownish or brownish-gray background broken by pale, interconnected narrow bands forming irregularly hexagonal or pentagonal figures; dorsal surface of head with hexagonal or pentagonal figures similar to those on body but much smaller and more closely spaced together. Most coloration on fins narrowly confined along fin rays; dorsal fin with faintly banded pattern; caudal fin with three to six dusky vertical bands. Paired fins without longitudinal bands or pale margins, pale or colorless posteriorly.

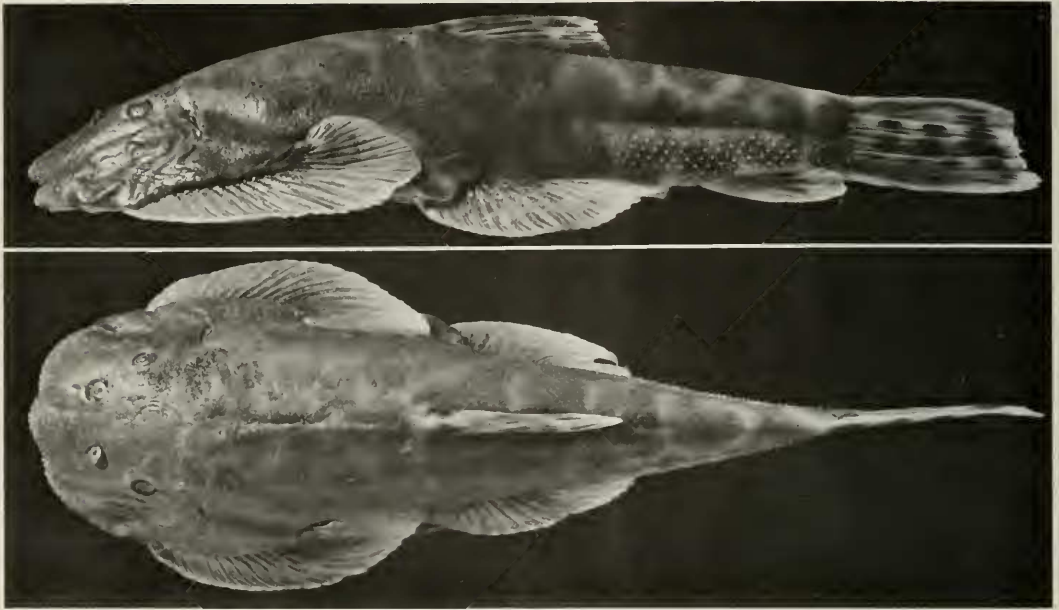


FIGURE 5. *Gastromyzon borneensis*, 71.5-mm male (IRSNB 19723).

Gastromyzon contractus new species

(Figures 2, 6)

TYPE-MATERIAL.—The types and only known specimens of this new species were collected in the mainstream and one small tributary of the Sungai Pinoh, a large high-gradient stream in the southern Kapuas basin, by Soetikno Woerjoatmodjo and me in July 1976.

Holotype.—MZB 3447, 34.4-mm gravid ♀, Sungai Tebelian, small forest stream 3–4 m wide and 50 cm deep, where it flows into Sungai Pinoh, 19 km upstream from Nangapinoh.

Paratypes.—CAS 49319, 1:30.2 mm, same data as holotype; MZB 3448, CAS 44186, USNM 230247, RMNH uncat., BMNH uncat., and MNHN uncat., 17:29.1–36.9 mm, mainstream of Sungai Pinoh 20–60 km upstream from Nangapinoh; MZB 3449 and CAS 49320, 2:25.9–29.8 mm, rocky channel in mainstream of Sungai Pinoh 37 km S of Nangapinoh.

DIAGNOSIS.—Perhaps the smallest species of *Gastromyzon* (largest known specimen 36.9 mm), *G. contractus* differs from all of its congeners in having depressed dorsal fin as well as pelvic fin reaching to or beyond level of anal-fin origin (depressed dorsal fin not reaching level of anal-fin origin, and pelvic fin reaching at most to anal fin in all other *Gastromyzon*).

Snout sloping downward in front of eyes more strongly than in most other *Gastromyzon*, but not so strongly as in *G. monticola* and *G. ridens*,

and broadly rounded. Postoral pouch absent. Gill opening slightly angular, extending anteriorly ventral to subopercle only a short distance, its length about equal to eye diameter; subopercular groove present, continuous but shallow or interrupted near its middle. Scales in lateral series 52–63; predorsal scales 36–44; scale rows above lateral series 16–20; circum-peduncular scales about 25–30. Pectoral fin overlaps pelvic fin. Male with dense patches of small conical tubercles on dorsal surface of anteriormost pectoral-fin rays (Fig. 2).

Dorsal and lateral surfaces of body with thick, pale, interconnected lines forming irregular hexagonal or pentagonal figures; dorsal surface of head with numerous small, round, dark spots. Dorsal fin with two or three spotted longitudinal bands; caudal fin with two or three dark vertical bands; coloration in dorsal and caudal fins concentrated along fin rays. Paired fins with faint markings, pelvic fins sometimes almost entirely colorless or colorless except basal portion dusky. Some specimens with dorsal and lateral surfaces of body and head blotchy or blanded, suggesting physiological or behavioral color change.

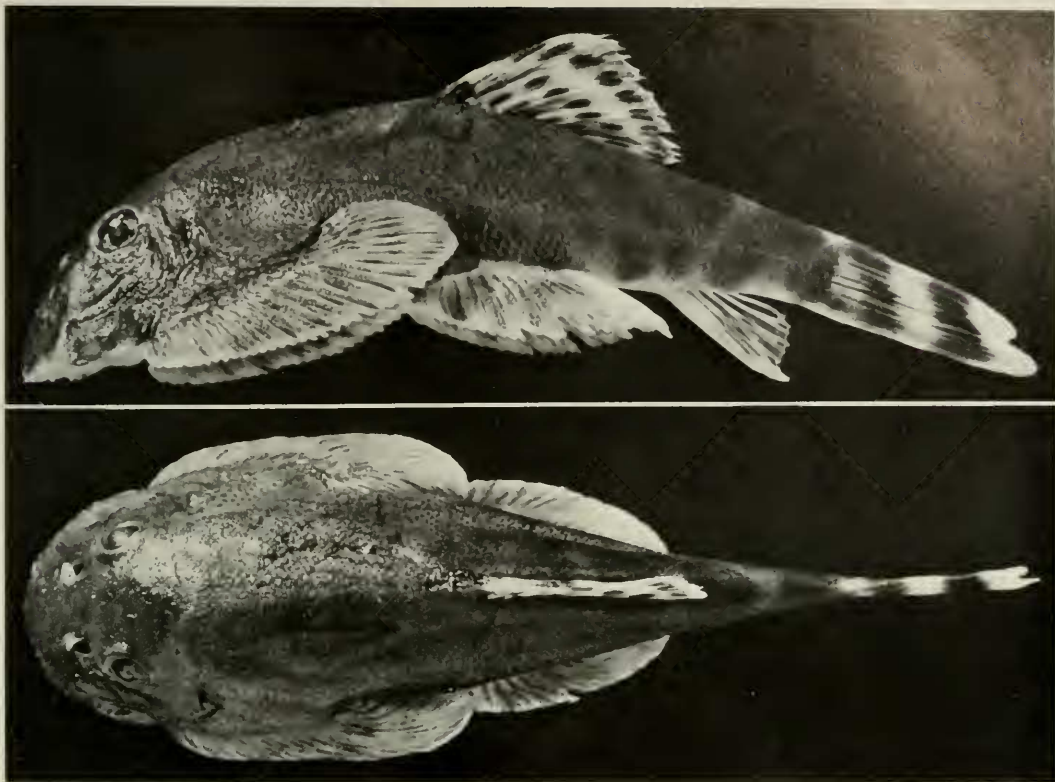


FIGURE 6. *Gastromyzon contractus*, 34.4-mm gravid female holotype (MZB 3447).

ETYMOLOGY.—From the Latin *contractus*, drawn together, in reference to the overlapping or nearness of the fins.

***Gastromyzon ctenocephalus* new species**

(Figure 7)

TYPE-MATERIAL.—This species is known only from the type-series, collected at Senah, Sarawak, by A. Everett.

Holotype.—BMNH 1893.3.6:269, 42.3-mm ♂, Senah, Sarawak.

Paratypes.—BMNH 1893.3.6:261–268, 8:28.9–37.8 mm, same data as holotype.

DIAGNOSIS.—*Gastromyzon ctenocephalus* differs from all other *Gastromyzon* in having only 8–12 papillae on lower lip, widely spaced on or near its free anterior margin (vs. extremely numerous papillae densely distributed over entire lower lip); gill opening strongly angular, continued farther anteriorly ventral to subopercle than in any other *Gastromyzon*; subopercular groove continuous and relatively deep (vs. subopercular groove continuous but relatively

shallow, interrupted in its middle, or absent); and sexually mature male with ctenoid tubercles on head and pectoral-fin base (ctenoid tubercles otherwise known only in male *Neogastromyzon pauciradiatus*).

Snout more or less strongly sloping downward in front of eyes, broadly rounded. No postoral pouch. Length of gill opening about 1.5–2 times eye diameter. Scales in lateral series about 50–60; predorsal scales about 32–36; scale rows above lateral series 15–20; circumpeduncular scales 28–30. Pectoral fin reaching or slightly overlapping pelvic fin; pelvic fin reaching anal fin; depressed dorsal fin falling short of level of anal-fin origin.

The holotype, a 42.3-mm male, has dense patches of small conical tubercles on dorsal surface of anteriormost branched pectoral-fin rays, as well as ctenoid tubercles on dorsolateral portion of head and on pectoral-fin base. A 32.6-mm male? has dense patches of small tubercles

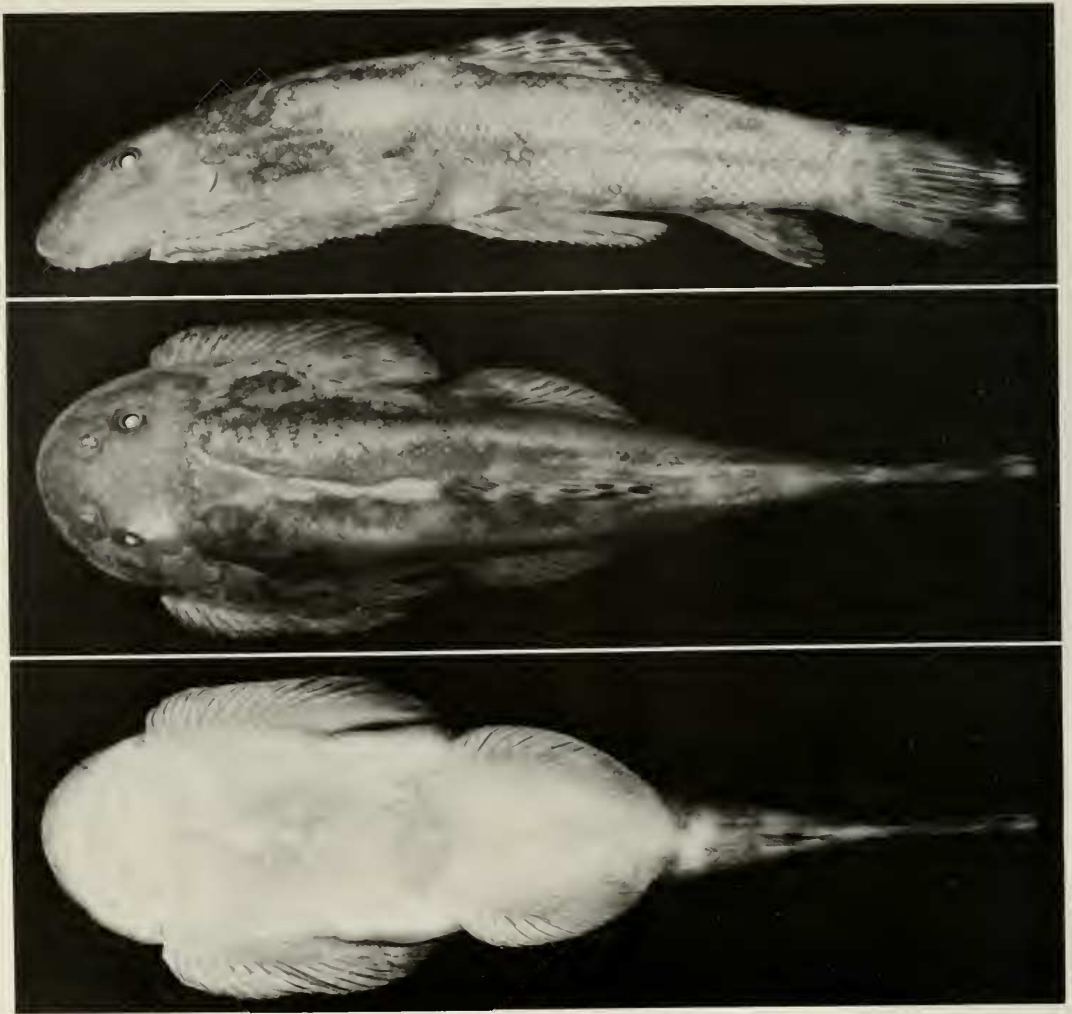


FIGURE 7. *Gastromyzon ctenocephalus*, 42.3-mm ripe male holotype (BMNH 1893.3.6.269).

on pectoral fin but no ctenoid tubercles. All other specimens, the three largest of which, 36.3–37.8 mm, are gravid females, lack ctenoid tubercles as well as dense patches of small tubercles on pectoral fin, but have numerous small conical tubercles widely scattered on dorsal surface of head and anteriormost portion of body (one tubercle per scale) as well as in uniserial rows of small conical tubercles on dorsal surface of pectoral-fin rays.

Dorsal surface of head with numerous small, round, pale spots; dorsal and lateral surface of body uniformly pale brownish (faded?) or, in

one paratype, with small, round, pale spots on dorsal surface of body and pectoral-fin base, similar to those on head but slightly larger and more widely spaced apart. In holotype, dorsal and anal fins with two longitudinal spotted bands, spots centered on rays; caudal fin with two or three faintly spotted vertical bands, and melanophores narrowly distributed along length of all rays; paired fins with faint longitudinal bands. In all paratypes, dorsal-fin rays and interradial membranes heavily pigmented except for depigmented areas forming an alternating series of transparent round spots; anal fin with in-

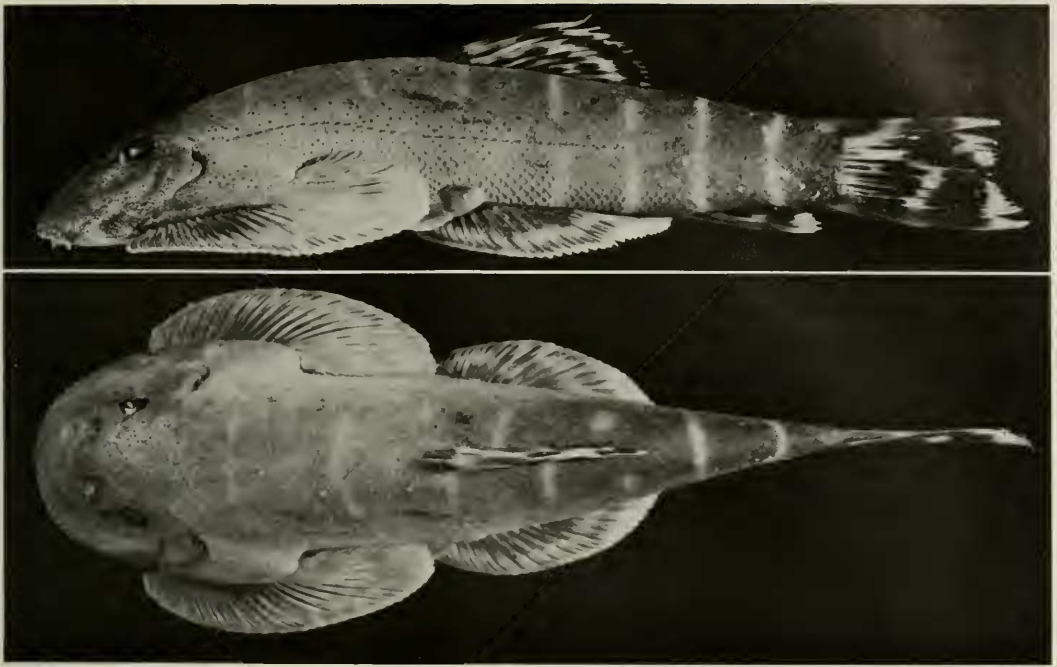


FIGURE 8. *Gastromyzon fasciatus*, 59.0-mm mature male (MZB 3450).

terradian membranes each bearing a single vertical, oblong, darkly pigmented spot and rays without coloration; caudal fin with simple principal rays and interradian membranes between principal rays unpigmented, but unbranched principal rays and interradian membranes between branches of individual rays darkly pigmented; paired fins longitudinally banded in some paratypes, without noticeable banding in others; one paratype with pectoral fin spotted. Coloration of dorsal, anal, and caudal fins of paratypes very different from that in other species of *Gastromyzon* and in holotype. This difference, perhaps due to individual variation or sexual dichromatism, should be investigated when additional material becomes available.

ETYMOLOGY.—From the Greek *cteno-*, comb, and *cephalus*, head, in reference to the ctenoid tubercles on the head of mature males.

Gastromyzon fasciatus Inger and Chin

(Figure 8)

Gastromyzon fasciatus INGER AND CHIN, 1961:173 (type-locality "Sungai Dapu, a tributary of the Baleh River near the mouth of the Sungai Putai, Third Division, Sarawak").

MATERIAL EXAMINED.—SARAWAK: FMNH 68115, 68120, and BMNH 1960.12.30:1, 6:48.1–65.9 mm, paratypes, Baleh

River, Rajang basin; FMNH 45852, 1:70.4 mm, Truson River, Lawas; FMNH 45853, 2:64.9–70.5 mm, Pa Brayong, Truson River; FMNH 68583, 3:44.1–51.0 mm, Akah River, Meligong; SU 32378, 1:45.1 mm, Sadong River; IRSNB 19725, 6:38.6–69.2 mm, Arur Dalan, torrential tributary of Padapur River, Baram basin. NORTH BORNEO: FMNH 68128, 5:20.6–46.5 mm, Sungai Kaingeran, Tambunan; FMNH uncat., 4:17.2–32.8 mm, Parutan River, Tambunan. KAPUAS BASIN: MZB 3450 and CAS 49321, 7:24.5–59.0 mm, Sungai Pinoh, RMNH 7636, 4:22.5–54.1 mm, Bongon. MAHAKAM BASIN: RMNH 7638, 2:53.2–56.8 mm, Bô; RMNH 7794, 2:39.2–54.3 mm, Bluu or Bloeoe.

DIAGNOSIS.—There does not seem to be any single character by which all specimens of *G. fasciatus* can be distinguished from all other species of *Gastromyzon*, but it is nevertheless a highly distinctive species. Predorsal scales 40–55 (usually less than 40 in all other *Gastromyzon*). Pelvic-fin and anal-fin rays usually more numerous than in other *Gastromyzon* (Table 1): branched pelvic-fin rays 20–24, modally 22 (vs. 17–22, modally 20 or less); branched anal-fin rays 5–5½, modally 5½ (vs. 4–5½, modally 5 or less). Specimens of *G. fasciatus* with well-developed coloration differ from all other *Gastromyzon* in having dorsal surface of head and body very darkly pigmented, black or bluish black, with narrow vertical white bars or white spots

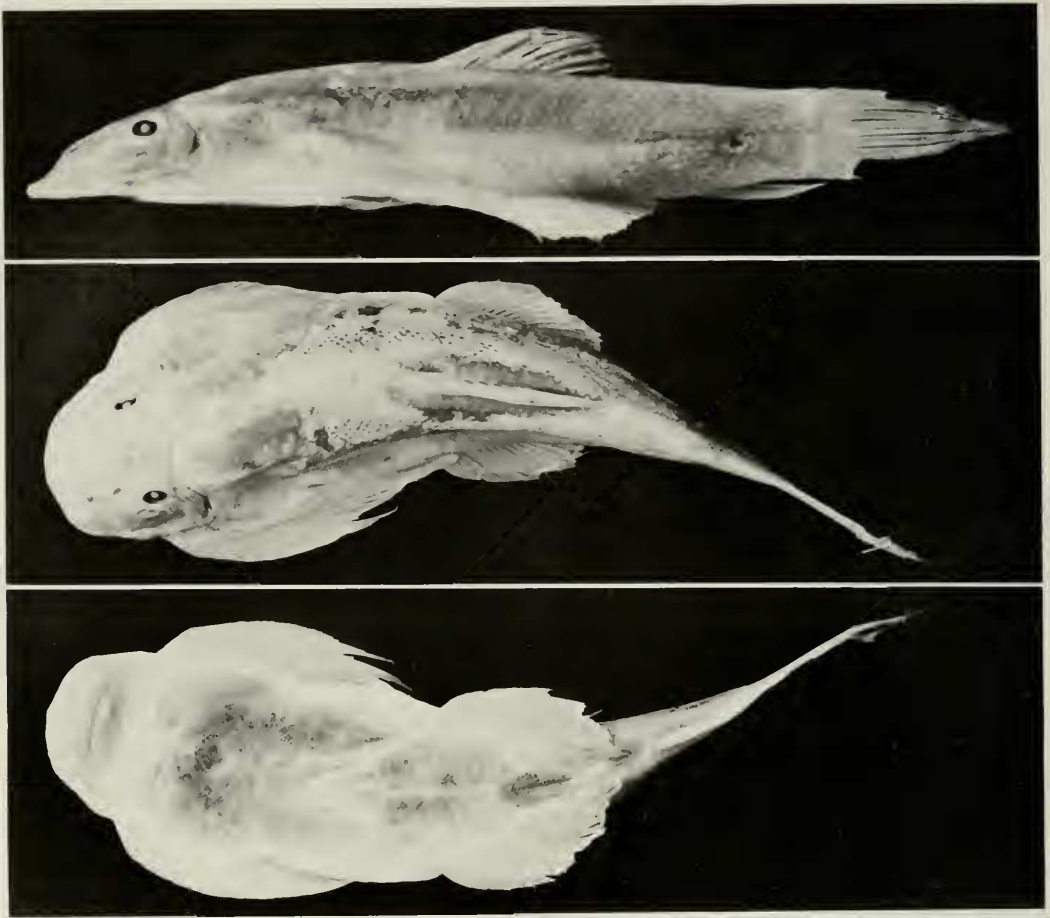


FIGURE 9. *Gastromyzon lepidogaster*, 78.0-mm holotype (BMNH 1874.11.24:5).

on body and disconnected white vermiculations on head. This coloration is well developed in freshly preserved specimens from Sarawak, North Borneo, and the Kapuas basin but is less well developed or indistinct in older material from the Mahakam basin.

Snout gently sloping downward in front of eyes, broadly rounded. No postoral pouch. Gill opening angular, extending anteriorly a short distance ventral to subopercle, its length about 1.5 times eye diameter. Subopercular groove always present, continuous or interrupted in the middle of its length. Scales in lateral series 55–68; scales above lateral series 20–23; circum-peduncular scales 30–43. Pectoral fin fails to reach pelvic fin; pelvic fin falls short of anal fin;

depressed dorsal fin falls far short of level of anal-fin origin. Male with dense patches of small tubercles on dorsal surface of anteriormost branched pectoral-fin rays.

Freshly preserved specimens, including paratypes from the Rajang basin and the Kapuas material, have very distinctive coloration different from all other *Gastromyzon*: dorsal and lateral surfaces of head and body darkly pigmented, black or bluish-black, with several pale or white vertical bands (sometimes breaking up into a few large spots) on body; dorsal fin with three or four longitudinal spotted bands, caudal fin with two or three almost solid, thick, vertical or irregularly broken black bands; paired fins irregularly spotted or mottled (not longitudinally

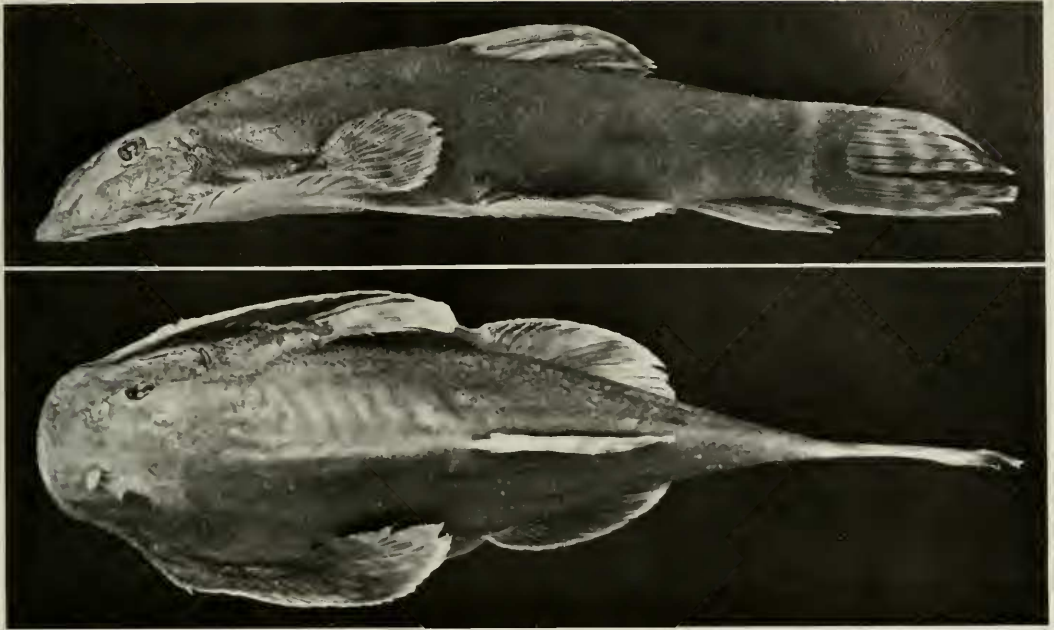


FIGURE 10. *Gastromyzon lepidogaster*, 62.9-mm ripe female paratype (FMNH 68113).

banded). Specimens from the Mahakam and some other collections, however, have less distinctive coloration, perhaps partly but not entirely due to fading after long preservation.

Gastromyzon lepidogaster new species

(Figures 9–10)

Gastromyzon borneensis GÜNTHER, 1874:6 (in part); POPTA 1906; WEBER AND DE BEAUFORT 1916 (Fig. 1, text; in part); INGER AND CHIN 1961; 1962 (in part).

TYPE-MATERIAL.—**Holotype:** BMNH 1874.11.24:5, 78.0 mm, sources of Mengalong River, Beaufort District, North Borneo.

Paratypes.—**NORTH BORNEO:** FMNH 68111–68114, 7:38.0–64.4 mm, Kinabatangan basin; FMNH 51683, 1:46.4 mm, East Coast Residency. **BRUNEI:** IRSNB uncat., 1:37.2 mm, upper course of Sungai Temburong. **KAJAN BASIN:** RMNH 7639, 3:79.0–83.3 mm, upper course of Boeloengan River above Ben Barum. **MAHAKAM BASIN:** RMNH 7635, 5:39.3–70.1 mm, upper Mahakam; RMNH 7637, 19:22.3–46.2 mm, Howong; RMNH 7794, 7:36.1–83.4 mm, Bluu or Bloeoe; RMNH 7638, 1:71.8 mm, Bō. **KAPUAS BASIN:** RMNH uncat., 1:72.3 mm, Bongan.

DIAGNOSIS.—*Gastromyzon lepidogaster* differs from all other *Gastromyzon* in having the abdomen more or less extensively covered with fine scales in all specimens examined over 40.2 mm and in many below this size (abdomen en-

tirely scaleless in all other *Gastromyzon* except in some specimens of *G. megalepis* which have a few relatively large scales between bases of posteriormost pelvic-fin rays).

Snout gently sloping downward in front of eyes, gently rounded. No postoral pouch. Gill opening vertical, its length about equal to eye diameter. No subopercular groove. Scales in lateral series 54–62; predorsal scales 39–42; scale rows above lateral series 16–20; circumpeduncular scales 30–32. Pectoral fin reaches or falls short of pelvic fin; pelvic fin reaches anal fin; depressed dorsal fin falls short of level of anal-fin origin.

All *Gastromyzon lepidogaster* from North Borneo and Sarawak have the abdomen completely covered with fine scales up to the level of the anterior margin of the pectoral girdle, except the smallest specimen (27.7 mm), which has the abdomen entirely scaleless. Specimens of this species from the Mahakam, Kajan, and Kapuas basins above 40.2 mm, and many below this size, have the abdomen completely covered with fine scales between the bases of the pelvic fins, and sometimes have scattered scales farther anteriorly, but never have the abdomen

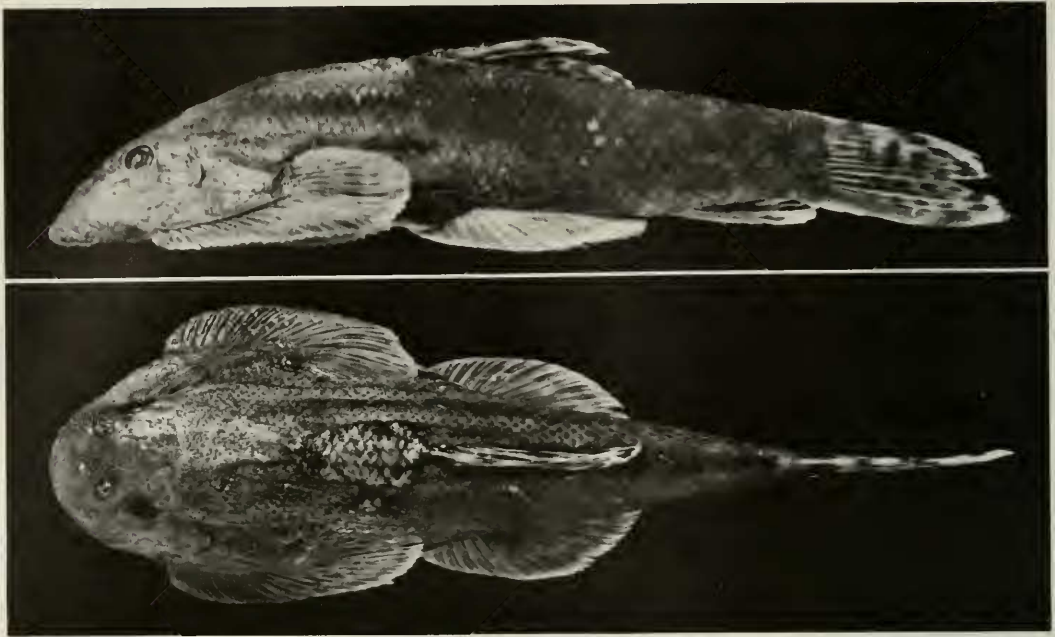


FIGURE 11. *Gastromyzon megalepis*, 54.6-mm mature male holotype (FMNH 68126).

completely covered with scales. They are similar in other respects to *G. lepidogaster* from North Borneo and Sarawak.

Dorsal and lateral surfaces of head and body uniformly brownish, or body with thin pale vertical bands (similar but slightly more numerous than those in *G. fasciatus*); bands on posterior portion of body in a few specimens interconnected to form irregularly pentagonal or hexagonal figures. Distal half of dorsal fin with two longitudinal spotted bands; caudal fin with broad dusky vertical band basally (on portion of fin covered by scales) and three or four lunate spotted bands on rest of fin. Anal and paired fins with faint markings, pectoral with spotted longitudinal bands, pelvic and anal with dusky coloration largely confined along rays.

ETYMOLOGY.—From the Greek *lepido-*, scale, and *gaster*, stomach, in reference to the extensive abdominal squamation.

Gastromyzon megalepis new species

(Figure 11)

Gastromyzon borneensis INGER AND CHIN, 1961:171 (in part).

TYPE-MATERIAL.—**Holotype:** FMNH 68126, 54.6-mm ♂, tributary of Baleh River between Sungai Entunau and Sungai

Putai, Rajang basin, Third District, Sarawak, R. F. Inger, 5 Aug. 1956.

Paratypes.—FMNH uncat., 5:45.1–60.5 mm, same data as holotype; FMNH 68127, 3:28.6–33.1 mm, Baleh River, Rajang basin, Third District, Sarawak.

DIAGNOSIS.—*Gastromyzon megalepis* has relatively larger scales than any other *Gastromyzon*; it is also the only *Gastromyzon* with pelvic fin lacking serrae. Scales in lateral series 44–48 (vs. 50 or more in all other *Gastromyzon*); predorsal scales 24–28 (vs. 30 or more); scale rows above lateral series 11–12 (vs. 15 or more); and circumpeduncular scales 20–21 (vs. 25 or more). Pelvic-fin rays 4–15 each with a sharp, dorso-posteriorly projecting continuous lamina or flange, without bony projections from individual lepidotrichia.

Snout gently sloping downwards in front of eyes, broadly rounded. No postoral pouch. Gill opening vertical, its length about 1.5 times eye diameter. Subopercular groove absent. Pectoral fin extends to pelvic-fin origin; pelvic fin extends almost to anal fin; depressed dorsal fin falls far short of level of anal-fin origin. Male with dense patches of minute tubercles on dorsal surface of anteriormost branched pectoral-fin rays.

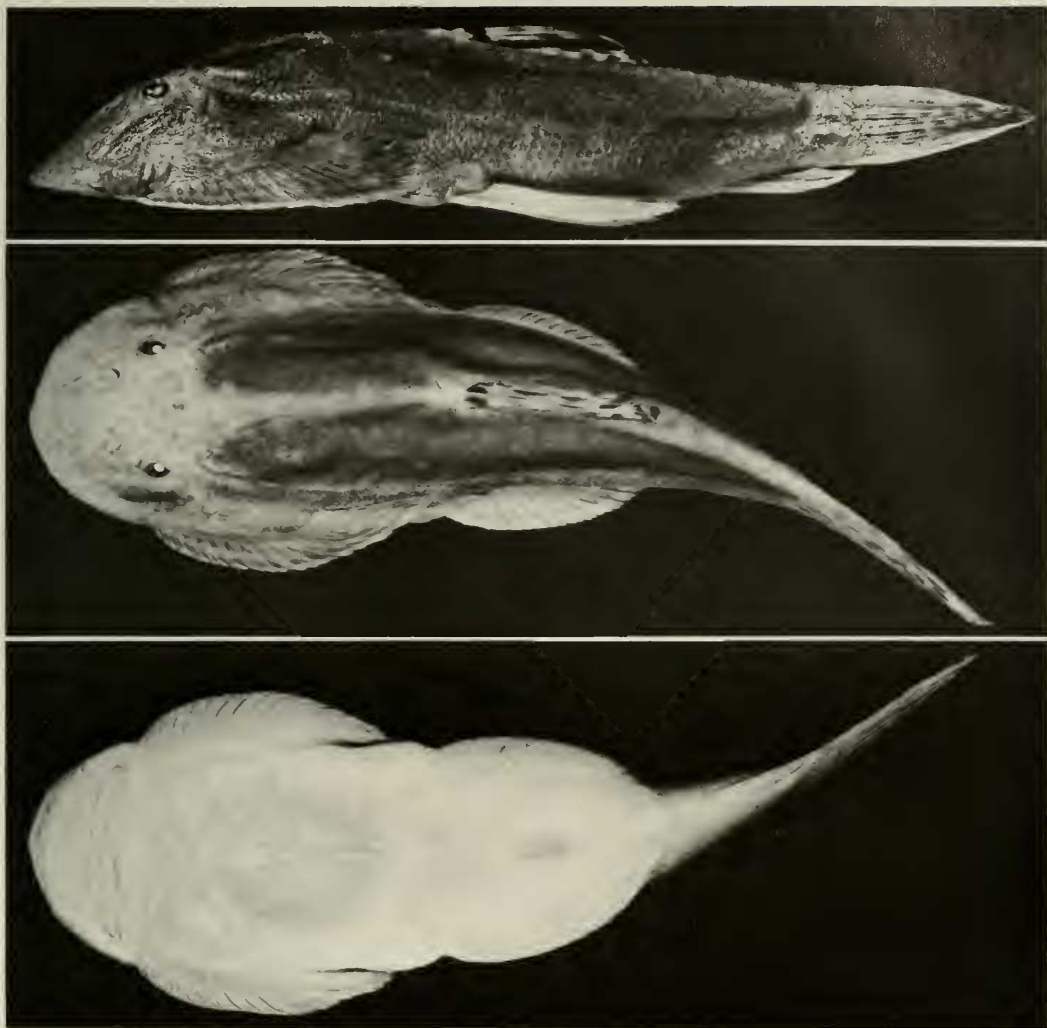


FIGURE 12. *Gastromyzon monticola*, 70.9-mm ripe female (BMNH 1894.6.30:196).

Dorsal and lateral surfaces of head and body uniformly brownish, sometimes mottled on caudal portion of body. Dorsal fin with four longitudinal spotted bands and caudal fin with about six lunate spotted bands, the spots nearly confined to fin rays; anal fin with melanophores uniformly distributed along rays; paired fins with faint longitudinal bands, pale margins.

ETYMOLOGY.—From the Greek *mega-*, large, and *lepis*, scale, in reference to the relatively large scales of this species.

Gastromyzon monticola (Vaillant)

(Figure 12)

Lepidoglanis monticola VAILLANT, 1889:81 (type-locality "Kina-Balou" = Mt. Kinabalu, North Borneo).

Gastromyzon monticola VAILLANT, 1891; 1893:94, pl. 1 (description and figures of syntypes).

Gastromyzon borneensis WEBER AND DE BEAUFORT, 1916 (in part).

This species has not been recognized by ichthyologists since it was placed in the synonymy of *Gastromyzon borneensis* by Weber and de

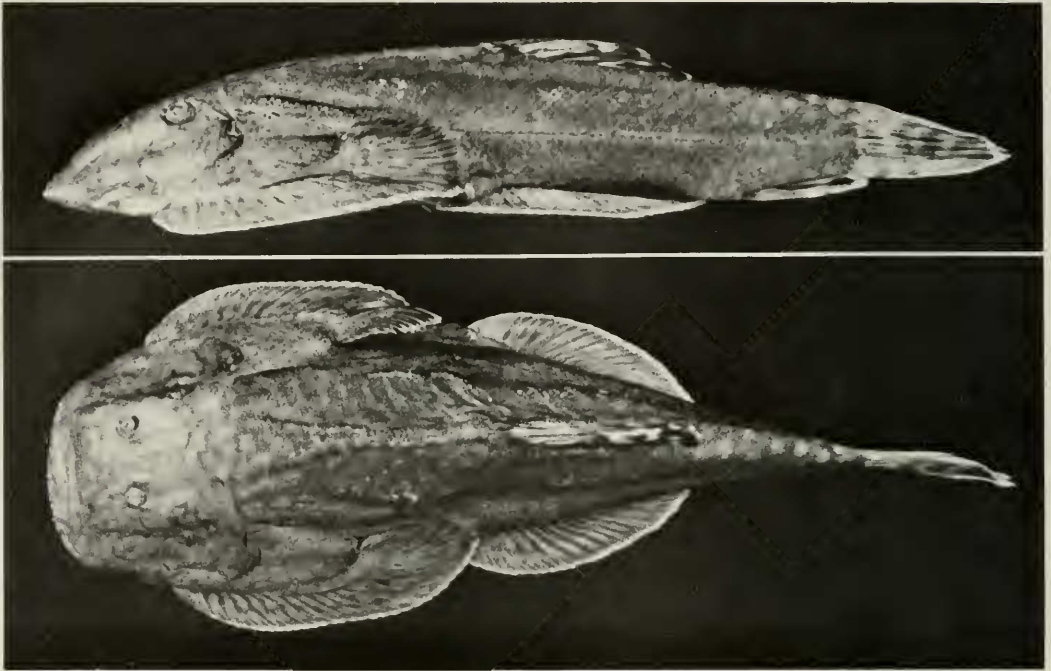


FIGURE 13. *Gastromyzon punctulatus*, 53.0-mm gravid female paratype (FMNH 68117).

Beaufort; it was entirely overlooked by Inger and Chin (1961).

MATERIAL EXAMINED.—All from NORTH BORNEO: MNHN 1889.83–85, 3; 63.5–67.1 mm, syntypes, Mt. Kinabalu (Vaillant 1889, indicated 10 syntypes but only these 3 could be located during my visit to the MNHN in November 1979); BMNH 1894.6.30:196–197, 2; 66.9–70.9 mm, Mt. Kinabalu (these two specimens were compared directly with the syntypes during my visit to the MNHN); FMNH 44725, 4; 33.2–56.3 mm, Tempassuk River, Kota Belud District, West Coast Residency.

In addition to the specimens just listed, I tentatively identify MCZ 54091, 2; 43.1–47.2 mm, Sarawak, as this species; these specimens were seen briefly during a visit to the MCZ and have not been considered in the account below.

DIAGNOSIS.—*Gastromyzon monticola* differs from all other *Gastromyzon* except *G. borneensis* in having a postoral pouch; it lacks a secondary rostrum and differs in many respects from *G. borneensis*. It differs from all other *Gastromyzon* except *G. ridens* and *G. contractus* in having the snout very strongly sloping downward in front of the eyes.

Snout broadly rounded or slightly pointed. Gill opening vertical, its length about equal to

eye diameter. Subopercular groove absent. Scales in lateral series about 55–58; predorsal scales about 40; scale rows above lateral series 20; circumpeduncular scales 30–32. Pectoral fin overlaps pelvic fin; pelvic fin reaches anal fin; and depressed dorsal fin falls far short of level of anal-fin origin.

Dorsal and lateral surfaces of body uniformly brownish; dorsal surface of head with interconnected thick pale lines forming irregularly hexagonal or pentagonal figures, very numerous and close-set. Dorsal, anal, and caudal fins with numerous small round spots centered on rays, forming about four longitudinal bands on dorsal fin, two (faint) bands on anal fin, and up to eight lunate spotted bands on caudal fin. A particularly prominent dark spot at dorsal-fin origin (a spot at dorsal-fin origin occurs in other *Gastromyzon* but is usually not so noticeable). Paired fins longitudinally banded, with a moderately wide pale distal marginal band, and a dark submarginal band of about equal width; pectoral fin spotted internal to these bands.

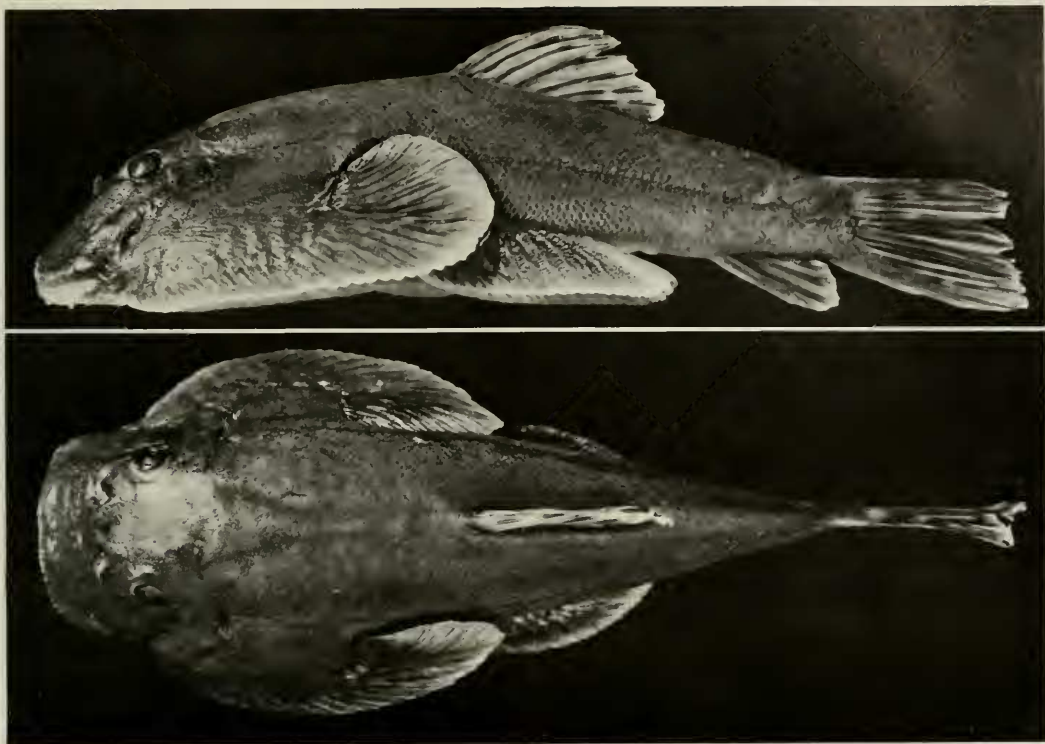


FIGURE 14. *Gastromyzon ridens*, 50.0-mm ripe male holotype (MZB 3455).

Gastromyzon punctulatus Inger and Chin

(Figure 13)

Gastromyzon punctulatus INGER AND CHIN, 1961:173 (type-locality "Sungai Dapu, a tributary of the Baleh River near the mouth of the Sungai Putai, Third Division, Sarawak").

This species is known only from the type-specimens collected in tributaries of the Baleh River, Rajang basin, Sarawak.

MATERIAL EXAMINED.—FMNH 68117, 3:32.9–53.6 mm, paratypes, same data as holotype.

DIAGNOSIS (partly after Inger and Chin 1961).—Larger specimens of *Gastromyzon punctulatus* differ from all other *Gastromyzon* except *G. ridens* in having a relatively truncate snout (vs. relatively more rounded in all other *Gastromyzon* and in smaller *G. punctulatus*) and a transverse row of papillae posterior to lower lip (not observed in any other *Gastromyzon*).

Snout gently sloping downward in front of eyes. No postoral pouch. Gill opening slightly

angular, its length about 1.5 times eye diameter. Subopercular groove broadly interrupted or absent in larger specimens, continuous in small specimens. Scales in lateral series about 58–59; predorsal scales about 40–42; scale rows above lateral series 21–22; circumpeduncular scales about 33. Pectoral fin reaches pelvic fin; pelvic fin falls short of anal fin; depressed dorsal fin falls short of level of anal-fin origin. Tubercles on dorsal surface of head, body, and fins minute or absent except for two or three rows of widely spaced small conical tubercles on anterior rim of snout. Dorsal surface of pectoral fin without dense patches of small tubercles.

Two largest specimens examined by me (53.0-mm gravid ♀ and 53.7-mm ripe ♂) with faint, pale round spots, relatively large, all about the same size, and lying close together, over entire dorsal surface of head and body including caudal peduncle; sides of body otherwise uniformly brownish; paired fins longitudinally banded, with pale (unpigmented) distal margins; dorsal-

fin and anal-fin rays dusky, interradiial membranes depigmented except for a few oblong dark spots; caudal fin with four or five dark narrow vertical bands. A small specimen, 32.9 mm, is similarly colored, but spots are more distinct, and those on head more variable in shape, vermiculate rather than round.

Gastromyzon ridens new species

(Figure 14)

TYPE-MATERIAL.—**Holotype:** MZB 3455, 50.0-mm ripe ♂, mainstream of Sungai Pinoh 20–60 km upstream from Nan-gapinoh, Kapuas basin, T. R. Roberts, S. Woerjoatmodjo, 21 July 1976.

Paratypes.—CAS 49322, FMNH 94228, USNM 230249, BMNH uncat., MNHN uncat., RMNH uncat., 7:24.3–35.7 mm, same data as holotype; BMNH 1893.3.6.270–275, 6:35.4–48.6 mm, Senah, Sarawak; SU 32378, 9:21.2–36.5 mm, Sadong River, Sarawak.

DIAGNOSIS.—*Gastromyzon ridens* differs from all other *Gastromyzon* in having sublacrimar groove very deep and enlarged, extending posteriorly onto cheek (vs. sublacrimar groove restricted to ventral surface of head in all other *Gastromyzon*); length of gill opening less than or barely equal to eye diameter (vs. equal to or greater than eye diameter); and snout relatively truncate, often with a slight ventral concavity at its tip (snout more rounded in all other *Gastromyzon* except *G. punctulatus*, which lacks ventral concavity at snout tip). Pectoral-fin rays 25–30, modally 27 (vs. 22–28, modally 26 or less in all other *Gastromyzon*; Table 1).

Snout strongly sloping downwards in front of eyes (more gently sloping in all other *Gastromyzon* except *G. contractus* and *G. monticola*). No postoral pouch. Gill opening vertical. No subopercular groove. Scales in lateral series 56–78; predorsal scales 32–52; scale rows above lateral series 15–26; circumpeduncular scales about 30–40. Pectoral fin considerably overlaps pelvic fin, perhaps more so than in any other *Gastromyzon* except *G. contractus*; pelvic fin falls short of anal fin; depressed dorsal fin falls far short of level of anal-fin origin. Male holotype, 50.0 mm, has serrae on pelvic fin relatively larger and more heavily developed than in any other specimen of *Gastromyzon* examined, and tubercles minute or absent on head, body, and fins except for numerous moderately large conical tubercles in a narrow band near snout tip. Serration and tuberculation of paratypes similar to that of holotype but less well developed, and some (♀ ♀) lack tuberculation on snout tip.

Dorsal and lateral surfaces of head and body entirely or almost entirely covered with small, pale round spots; some specimens with posterior portion of body, body posterior of head, or entire head and body more or less uniformly pale or blanched, suggesting behavioral or physiological color change (as in *G. contractus*). Fins dusky or faintly marked, median fins with melanophores mainly confined along fin rays.

ETYMOLOGY.—From the Latin *ridens*, laughing or smiling, in reference to the peculiar countenance of this species caused by the extension of the sublacrimar groove onto the side of its head.

Glanioipsis Boulenger

Glanioipsis BOULENGER, 1899:228 (type-species *Glanioipsis hanitschi* Boulenger, 1899, by monotypy).

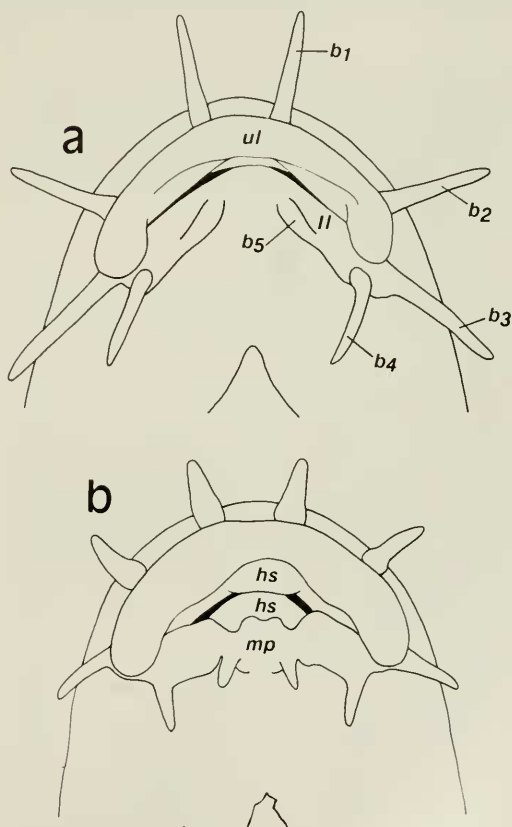


FIGURE 15. Ventral surface of head. (a) *Glanioipsis hanitschi*; (b) *Glanioipsis multiradiata* (b_1 , b_2 , b_3 = rostral, maxillary, mental barbels; b_4 , b_5 = mandibular barbels; hs = horny sheaths of upper and lower jaws; ll , ul = lower lip, upper lip; mp = mental pad).

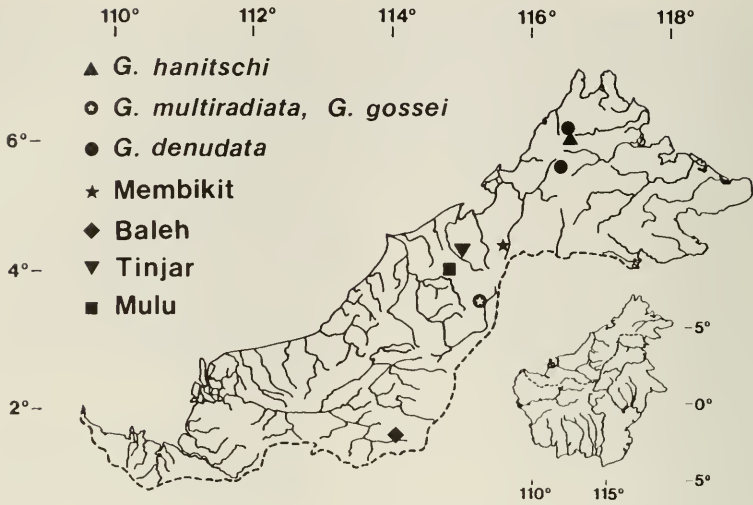


FIGURE 16. Distribution of *Glaniopsis*.

DIAGNOSIS.—*Glaniopsis* differs from all other *Gastromyzontinae* in having a subterminal (rather than inferior) mouth, and from all other Bornean *Gastromyzontinae* in having two (instead of only one) mandibular barbels at each corner of mouth (Fig. 15).

Dorsal fin with two simple and six or seven branched rays; anal fin with two simple and five branched rays; posteriormost dorsal-fin and anal-fin rays not split to base. Pectoral and pelvic fins widely separated; pectoral fin with one simple and 11–17 branched rays, with an outer “adhesive” and inner “vibratory” portions (Hora and Jayaram 1951), its origin posterior to head. Pelvic fins separate, each with 1 simple and 7–10 branched rays. Suprapelvic flap absent. Adhesive pads present on first three to five pectoral-fin rays and first three pelvic-fin rays. Sexually mature males with small or minute tubercles widely distributed on head, body, and fins; males with most highly developed tuberculation have median-fin rays and dorsal surface of paired-fin rays with uniserial rows of conical tubercles; tubercles on body minute, pricklelike, usually one per scale (many scales without tubercles). Females nontuberculate except for a few small conical tubercles in uniserial rows on dorsal surface of anteriormost four or five pectoral-fin rays.

Key to *Glaniopsis*

- 1a. Dorsal fin with 7 branched rays 2
- 1b. Dorsal fin with 6 branched rays 3

- 2a. Pectoral fin with 15–17 and pelvic fin with 8–10 branched rays *G. multiradiata*
- 2b. Pectoral fin with 12–14 and pelvic fin with 6–9 branched rays Baleh, Tinjar, and Mulu *Glaniopsis* (see accounts below for additional information)
- 3a. Maximum of nine lateral scale rows (mid-lateral scale row plus three scale rows above and five scale rows below it); principal caudal-fin rays usually less than 9+9 (most often 8+8) *G. denudata*
- 3b. At least 20 lateral scale rows; principal caudal-fin rays almost always 9+9 4
- 4a. Caudal peduncle depth 7.6–9.4; adpressed nasal barbel extends posteriorly at least to posterior margin of eye; eye diameter 30–42, 3.5–4.6 in interorbital width; horny sheath of upper jaw varying from gently convex to strongly projecting (beaklike) *G. hanitschi*, Membikit *Glaniopsis* (see accounts below for additional information)
- 4b. Caudal peduncle depth 9.2–12.2; adpressed nasal barbel extends posteriorly no farther than middle of eye; eye diameter 24–30, 2.2–3.1 in interorbital width; horny sheath of upper jaw varying from slightly concave to strongly notched medially *G. gossei*

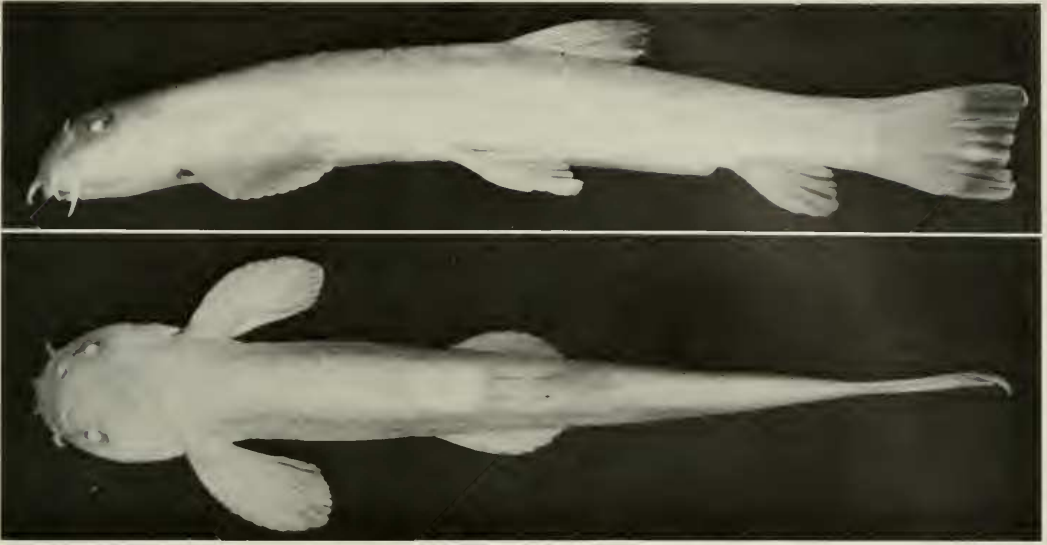


FIGURE 17. *Glaniopsis denudata*, 34.5-mm mature male holotype (BMNH 1957.2.27:1).

Glaniopsis denudata new species

(Figure 17)

TYPE-MATERIAL.—**Holotype:** BMNH 1957.2.27:1, 34.5 mm. Sungai Kidikarok, North Borneo; altitude 4500 ft [ca 1370 m]; 26 Aug. 1956; Cambridge North Borneo Expedition.

Paratypes.—BMNH 1957.2.27:2–15, 14:19.4–34.9 mm. Same collection data as holotype; IRSNB 618, 1:41.8 mm. Sungai Silau Silau, a headwater tributary of Sungai Liwagu, Labuk basin, near Tenompok, Mount Kinabalu, altitude 5000 ft [ca. 1500 m]; 7 Oct. 1971; Léopold III, J. P. Gosse.

DIAGNOSIS.—*Glaniopsis denudata*, perhaps the smallest species of *Glaniopsis*, differs from all other *Glaniopsis* in having extremely reduced squamation and usually fewer than 9+9 principal caudal-fin rays. Largest specimen a gravid female, 41.8 mm. Squamation consists of lateral scale series plus maximum of about three scale rows above and five below it, or total of about nine scale rows (vs. 20 or more in all other *Glaniopsis*). Principal caudal-fin rays variable, most often 8+8, perhaps always less than 9+9. Sexually mature males with minute, pricklelike tubercles scattered on abdomen in front as well as behind pelvic fins. Dorsal-fin origin distinctly posterior to a vertical through base of last pelvic-fin ray. Pelvic-fin origin much nearer pectoral-fin origin than to anal-fin origin.

Eye 17–25, 1.9–2.6 in interorbital space. Interorbital space 9.7–12.7. Branched dorsal-fin rays 6(13). Principal caudal-fin rays variable, most often 8+8; ?9+?9(1), 9+8(1), 9+8 or 9+9(1), 8+9(1), 8+8(6), 7+8(1). Pectoral-fin rays il3(6), il4(6), or il5(1). Pelvic-fin rays i7(13).

Length of nasal, outer mandibular, and sometimes maxillary barbels about equal to or slightly more than eye diameter, otherwise length of barbels less than eye diameter. Addressed nasal barbel failing to reach exposed portion of eye or at most reaching only slightly beyond front margin of eye. Mental barbel flaplike.

Lateral scale series incomplete, with 102–111 scales, some scales absent or missing posteriorly, which, if present, would yield counts of about 115–120 (observations on three specimens lightly stained with alizarin). Dorsum and abdomen entirely scaleless. Tubed scale series complete or continuous on anterior one-fourth to one-half of body, always arrested before level of dorsal-fin origin and entirely absent posteriorly. In specimens less than 24 mm, tubed scale series absent or absent except for short anterior segment of up to about six tube-bearing scales. Myotomal muscle masses more sharply defined externally than in any other *Glaniopsis*, divisions between them clearly visible for entire length of body (vs. scarcely noticeable at all, or clearly visible only on posterior third of body).

All specimens in type-series with nearly identical coloration. Head without markings, dusky dorsally and laterally to just below level of eyes, without melanophores ventrally. Oral barbels and lips without melanophores. Upper fourth to half of body dusky, with fine melanophores uniformly distributed everywhere except in vicinity

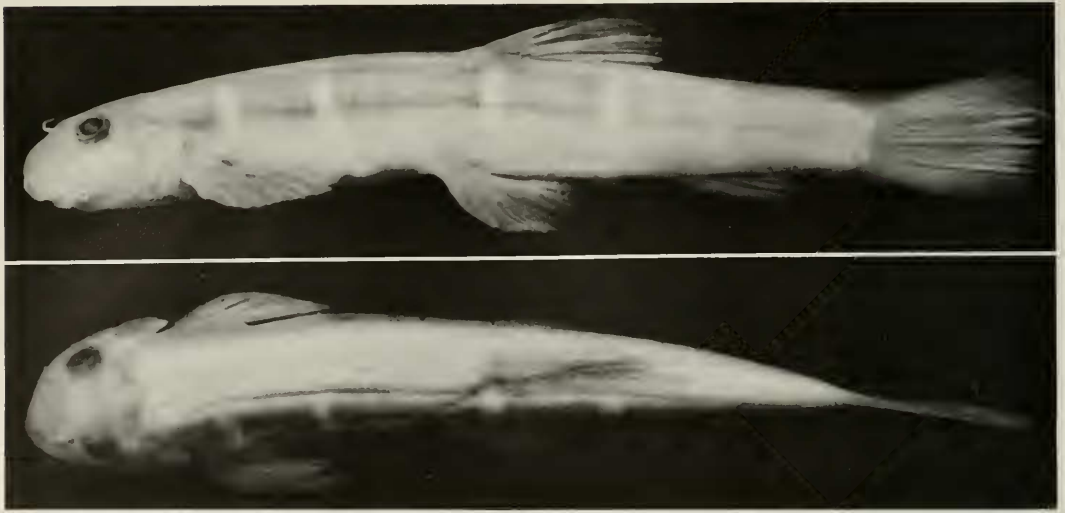


FIGURE 18. *Glaniopsis gossei*, 40.5-mm mature male holotype (IRSNB 621).

of dorsal-fin base: a dark area due to densely clustered fine melanophores circumscribing dorsal-fin base; a pallid area with few or no melanophores extending on dorsum in front of dorsal fin for a distance about equal to dorsal-fin base (some juvenile specimens of *G. hanitschi* display a tendency toward this coloration, but with much less marked contrast between dark and pallid areas; similar coloration not observed in juveniles or adults of other *Glaniopsis*). Lower half of body pale, without melanophores except near midline of body, dusky area dorsal to pectoral-fin base, very faint dusky area lateral to pelvic-fin base, and dark area lateral to anal-fin base due to concentrations of melanophores. Fins unpigmented or dusky, without distinct markings except for concentration of melanophores on caudal-fin base immediately posterior to hypural fan.

ETYMOLOGY.—The feminine adjective *denu-data*, Latin, “nude,” refers to the very limited squamation and sharply defined myotomal muscles characteristic of the species.

Glaniopsis gossei new species

(Figure 18)

TYPE-MATERIAL.—**Holotype:** IRSNB 621, 40.5 mm. Arur Dalan, a torrential headwater of Sungai Padapur, Baram basin, near Bario, Sarawak; altitude 3500 ft [ca. 1100 m]; 11 Oct. 1971; Léopold III, J. P. Gosse.

Paratypes.—IRSNB 622, 19:28.6–46.5 mm. Same collection data as holotype.

DIAGNOSIS.—*Glaniopsis gossei* differs from all other *Glaniopsis* in having a series of depigmented vertical bars on sides of body (these may be lost or obscured in specimens which are pallid, as if bleached or faded) and horny sheath of upper jaw strongly notched or concave medially, rather than strongly convex medially (beaklike) or evenly curved. It also differs from *G. hanitschi* in having larger eyes, narrower interorbital space, and shallower caudal peduncle; from *G. multiradiata* in having fewer dorsal, pectoral, and pelvic-fin rays, larger eyes, and longer barbels; and from *G. denudata* in having more extensive squamation.

Eye diameter 24–30, 2.2–3.1 in interorbital space. Interorbital space 9.2–11.0. Depth caudal peduncle 9.2–12.2. Branched dorsal-fin rays invariably 6 (20). Principal caudal-fin rays 9+9 (19; one specimen with broken fin not counted). Pectoral-fin rays i11 (2), i12 (14), or i13 (3). Pelvic-fin rays i7 (20). Dorsal-fin origin on a vertical through origin of last pelvic-fin ray or slightly posterior to it. Pelvic-fin origin closer to anal-fin origin than to pectoral-fin origin.

Length of nasal and outer mandibular barbels about 1.5 times eye diameter. Length of other barbels except mental barbel about equal to eye diameter. Adpressed nasal barbel extends posteriorly at least to middle of eye but not beyond exposed portion of eye. Mental barbel barbel-

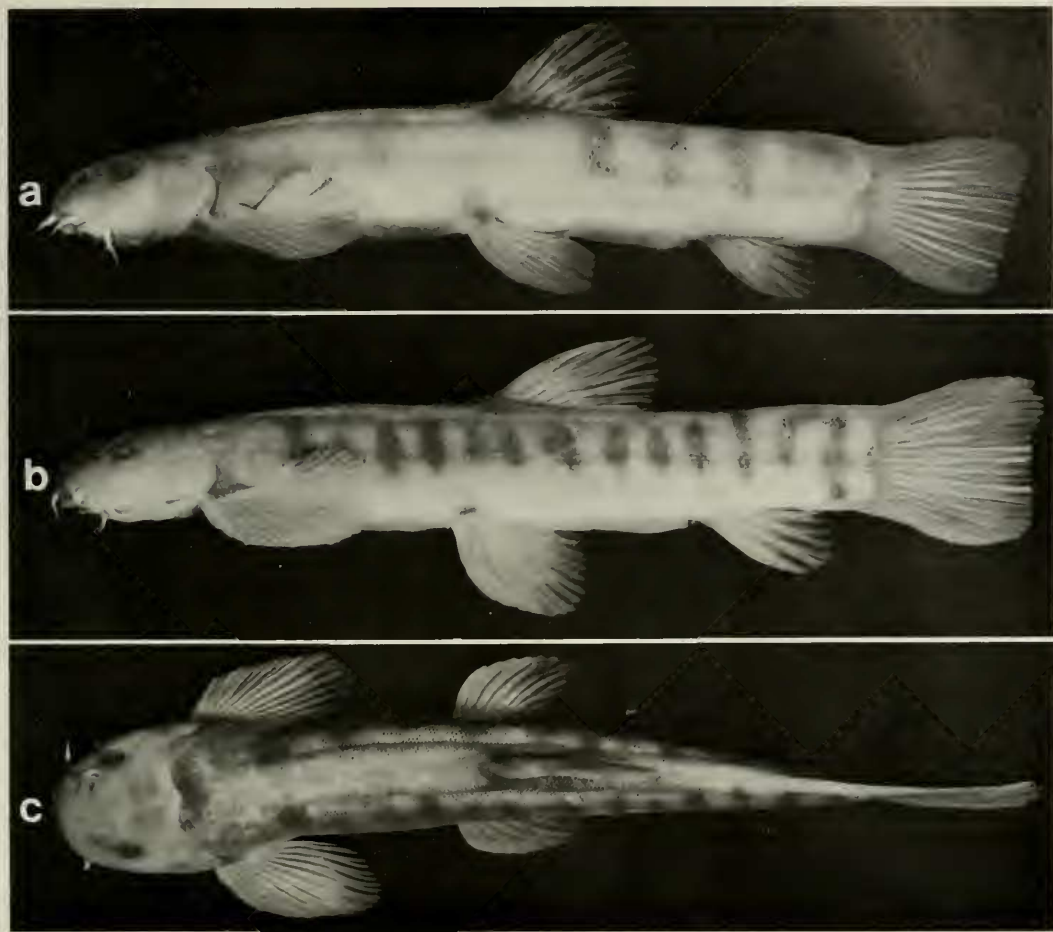


FIGURE 19. *Glaniopsis hanitschi*. (a) 59.4-mm mature male (IRSNB 17540); (b, c) 59.4-mm mature female (IRSNB 17541).

like, about one-half as long as inner mandibular barbel.

Sides of body completely covered with scales which tend to be embedded (without free posterior margins) and slightly dispersed (not overlapping), especially on posterior half of body, making them difficult to count. Over 100 scales in lateral series. Dorsum in front of dorsal fin scaleless, behind dorsal fin covered with scales. Entire abdomen scaleless(?) except for a few scales near vent and anal-fin origin. Tubed scale series complete on anterior half of body, variably interrupted on posterior half.

ETYMOLOGY.—Named for Jean-Pierre Gosse, who collected much of the material reported upon in this paper, including the type-series of this species.

Glaniopsis hanitschi Boulenger

(Figures 15a, 19)

Glaniopsis hanitschi BOULENGER, 1899:228 (type-locality Kadamaian River, Mount Kinabalu, altitude 2100 ft [ca. 640 m]).

MATERIAL EXAMINED.—IRSNB 17540, 52:31.7–70.8 mm, Sungai Silau Silau, a headwater tributary of Sungai Liwagu, Labuk basin, near Tenompok, Mount Kinabalu, altitude 5000 ft [ca. 1500 m]; IRSNB 17541, 28:17.6–69.3 mm, headwater tributary of Sungai Liodan, below Bundu Tahun, Mount Kinabalu, altitude 4000 ft [ca. 1200 m]; FMNH 68950, 1:53.7 mm, Sungai Kelangaan, near Mesilan base camp, Mount Kinabalu, altitude 5000 ft [ca. 1500 m]; FMNH 47985, 1:58.7 mm, Jesselton District.

DIAGNOSIS.—*G. hanitschi* is the largest and most robust *Glaniopsis*, attaining 97 mm, with the deepest caudal peduncle, broadest interorbital width, smallest eyes, and longest barbels.

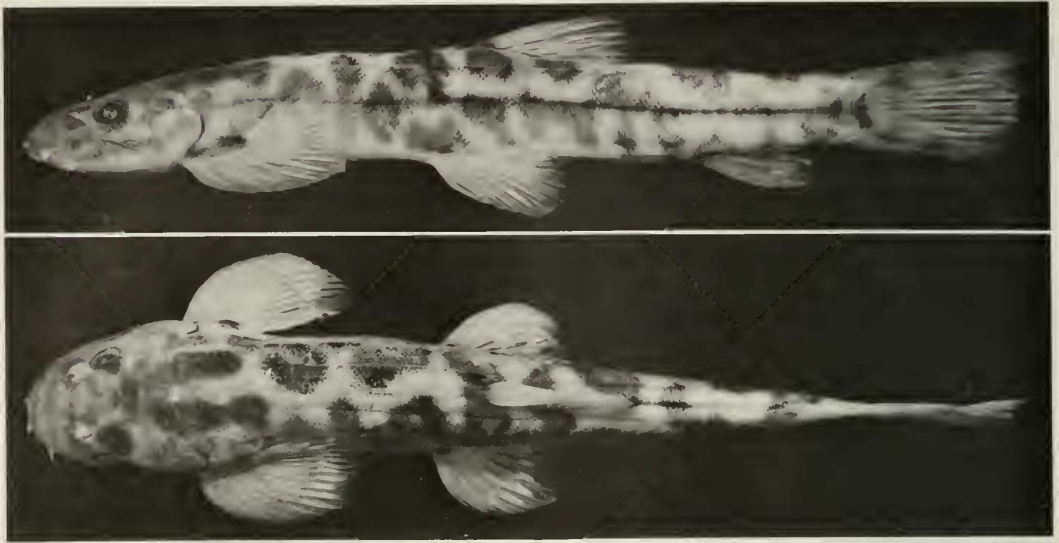


FIGURE 20. *Glaniopsis multiradiata*, 44.5-mm female holotype (IRSNB 619).

Caudal peduncle depth 7.6–8.9 (vs. 9.2–12.7 in all other species); interorbital width 7.9–9.6 (vs. 9.2–12.7); eye diameter 30–42, 3.7–4.6 in interorbital width (vs. 17–37, 1.9–3.1 in interorbital width); and adpressed nasal barbel invariably extending posteriorly beyond exposed portion of eye. Mental barbel flaplike.

Branched rays in dorsal fin 6 (30) (7 in two specimens with posteriormost ray abnormal), in pectoral fin 12 (20) or 13 (12), and in pelvic fin 6 (1), 7 (30), or 8 (1). Principal caudal-fin rays 9+9 (22) or 10+9 (1) (8+9 in one specimen with anomalous vertebral column).

Sides of body entirely covered with close-set, regularly overlapping scales with exposed posterior margins except for a small scaleless area immediately above base of pectoral fin. Nearly 30 complete scale rows near middle of body and 20 or more on caudal peduncle. Midlateral scale row complete, with about 125–146 scales (19). Dorsal surface of body anterior to dorsal fin varying from scaleless to covered with scales for five-sixths of distance to occiput, but never completely scaled. Dorsal surface of body posterior to dorsal fin completely covered with scales, or with only small scaleless areas immediately posterior to dorsal fin and on keel-like ridge over upper procurent caudal-fin rays. Ab-

domen scaleless or nearly scaleless except for a few dispersed, embedded scales near anal-fin base and just anterior to vent. Lateral line canal tube-bearing scale series usually complete on anterior half of body, variably interrupted or incomplete on posterior half of body.

Head without markings. Body with 7–18 vertical or slightly oblique dark bars, mainly on dorsal half of sides, partially breaking up into upper and lower portions in some specimens, and regularly or irregularly arranged, sometimes dropping out or “fusing”; some bars may extend below midlateral line, and an occasional bar may lie entirely below it, especially in the caudal region, but bars do not continue onto or across dorsum either in front or behind dorsal fin. Anteriormost bar usually immediately behind head, posteriormost just in front of caudal-fin insertion; usually a bar near dorsal-fin origin. In some specimens two or more bars “fuse” to form a single broad mark. Bars absent or faint in specimens less than 32 mm. A few larger specimens with a narrow darkly pigmented area paralleling occiput and traversing dorsum immediately posterior to head. Two large specimens with separate markings which resemble bars on side of body and traverse dorsum anterior to dorsal fin. All specimens with a dense cluster of melano-

phores, sometimes faint, on lateral surface of pelvic-fin base and sometimes extending onto basal portion of first 1–2 pelvic-fin rays. Dorsum and sides of body with lozenge-shaped clusters of melanophores centered on each scale. Dorsal and lateral surfaces of head, nasal barbel, upper lip, dorsal and caudal fins, and dorsal surface of paired fins dusky. Ventral and ventrolateral portions of body, ventral surface of head excluding upper lip, lower lip, all barbels except nasal barbel, and ventral surface of paired fins colorless or depigmented (without melanophores).

Glanioptis multiradiata new species

(Figures 15b, 20)

TYPE-MATERIAL.—**Holotype:** IRSNB 619, 44.5 mm. Arur Dalan, a torrential headwater of Sungai Padapur, Baram basin, near Bario, Sarawak; altitude 3500 ft [ca. 1100 m]; 11 Oct. 1971; Léopold III, J. P. Gosse.

Paratypes.—IRSNB 620, 30:24.3–59.1 mm. Same collection data as holotype.

DIAGNOSIS.—*Glanioptis multiradiata* has more rays in the paired fins and shorter barbels than any other *Glanioptis*: pectoral-fin rays i15–17, usually i16 (vs. i11–14 in other species of *Glanioptis*); pelvic-fin rays usually i9, exceptionally i8 or i10 (vs. usually i7, exceptionally i6 or i8); and length of all barbels equal to or less than eye diameter, adpressed nasal barbel usually failing to reach exposed portion of eye.

Eye diameter 20–37, 2.0–3.1 in interorbital space. Interorbital space 9.3–12.6. Depth caudal peduncle 9.7–12.3. Branched dorsal-fin rays invariably 7 (31). Branched anal-fin rays invariably 5 (31). Principal caudal-fin rays 9+9 (14), 9+8 (1). Pectoral-fin rays i15 (4), i16 (8), or i17 (7). Pelvic-fin rays i8 (2), i9 (28), or i10 (1). Dorsal-fin origin on a vertical through origin of last pelvic-fin ray or slightly posterior to it. Pelvic-fin origin closer to anal-fin origin than to pectoral-fin origin.

Length of all barbels usually less than eye diameter. Outer mandibular barbel longest, its length usually less than, but sometimes equal to, eye diameter. Adpressed nasal barbel usually failing to extend posteriorly to exposed portion of eye, at most extending slightly beyond free anterior margin of eye. Mental barbel barbel-like, half as long as inner mandibular barbel.

Sides of body completely covered with close-set, regularly overlapping scales with exposed posterior margins, except for a small naked area just above pectoral-fin base; about 30 complete

scale rows near middle of body and 20 on caudal peduncle. Lateral scale row complete, with about 106–130 scales (17). Dorsum in front of dorsal fin usually covered with scales almost to occiput, always scaled for at least half its length in front of dorsal fin. Dorsum posterior to dorsal fin completely scaled except for a small scaleless area immediately posterior to dorsal fin in some specimens. Abdomen posterior to pelvic fins covered with embedded scales. Abdomen anterior to pelvic fins scaleless except for a few embedded scales median to pelvic-fin bases. Ventral surface of body posterior to anal fin completely scaled. Tubed scale series either complete, complete except for a few scales without tubes near end of series, or with short tubeless segments on posterior half of body in a few specimens.

Glanioptis multiradiata has a variably mottled coloration distinct from that of other *Glanioptis*. Mottles largest and best defined on dorsum, especially anterior to dorsal fin; fainter and smaller but similar mottles extend onto the head, including gill covers, cheeks, and snout in a few specimens; almost all specimens have mottles on dorsum, although varying in distinctness, except for two smallest specimens, 24.3 and 29.2 mm, which are pallid, as if bleached. Majority of specimens partially decolorated, either on one or both sides, as if bleached. Path of lateral line marked by a thin dark longitudinal band which is absent or much less distinct in other *Glanioptis* and which persists in specimens otherwise largely decolorated. In specimens with mottlings on sides of body, these tend to be less prominent than those on dorsum. Abdomen colorless. Fins darkly pigmented compared to other *Glanioptis*. Caudal fin in many specimens with three wavy vertical bands. Dorsal and anal fins with slight concentrations of melanophores suggesting incipient barred pattern. Dorsal, anal, and dorsal surfaces of paired fins often with fine melanophores concentrated along fin rays, giving them a dusky appearance. Dorsal surface of pectoral-fin base dusky or darkly pigmented, more so than in other *Glanioptis*. A cluster of melanophores on lateral surface of pelvic-fin base.

Compared to *Glanioptis hanitschi*, *G. multiradiata* has body slightly more elongate or slender, especially posteriorly; snout more depressed; ventral surface of head flatter; lips (especially lower) slightly less arcuate; lower lip

interrupted medially by feebly developed mental pad from posterolateral corners of which mental barbels arise; bases of outer and inner mandibular barbels more widely separated; dorsal fin slightly smaller; caudal fin (correlated with shallower caudal peduncle) much smaller; caudal fin slightly forked, its upper lobe slightly larger (rather than truncate); and paired fins larger. Pectoral fin about 10–15% longer, its surface area when expanded about one-third greater; first pectoral-fin ray noticeably curved or bowed posteriorly instead of nearly straight or only slightly curved; fringes on distal ends of branched rays less well developed; adhesive pads on ventral surface of outermost rays thicker; and base of pectoral fin fully one-third longer.

ETYMOLOGY.—The feminine adjective *multi-radiata* comes from *multus*, Latin, “much,” plus *radiata*, Latin, “rayed,” in reference to the more numerous pectoral-fin and pelvic-fin rays characteristic of the species.

Membikit *Glanioipsis*

Glanioipsis hanitschi (in part) INGER AND CHIN, 1962:107–108 (specimens from Sungai Membikit).

MATERIAL EXAMINED.—FMNH 68135, 3:46.5–52.4 mm. Sungai Membikit [tributary of Sungai Pegalan, Padas basin, near southern end of Crocker range], Keningau District, Sabah, 5°22'N, 116°06'E.

These three specimens resemble *G. hanitschi* more closely than they do any other *Glanioipsis* but differ from typical *G. hanitschi* from Mount Kinabalu in having head narrower and more depressed, fins smaller, and abdomen more extensively covered with scales anterior to pelvic fins. Two of the three specimens also have fewer pectoral-fin rays and a more incomplete tubed scale series.

Eye 34–43, 3.5–4.1 in interorbital space. Interorbital space 10.3–10.8 (vs. 7.9–9.6 in *G. hanitschi*). Depth caudal peduncle 9.0–9.4 (7.6–8.9 in *G. hanitschi*). Branched dorsal-fin rays 6 (3). Branched anal-fin rays 5 (3). Principal caudal-fin rays 9+9 (2), 9+7 (1, with caudal fin probably injured or abnormally developed). Pectoral-fin rays i11 (2) or i12 (1) (i12 or more in *G. hanitschi*). Pelvic-fin rays i7 (3).

Adpressed nasal barbel reaching to or slightly beyond free posterior margin of eye. Upper and lower horny jaw sheaths markedly convex near symphysis.

Dorsum and sides of body nearly completely

covered with scales, lateral series complete with about 130–142 scales, about 35 complete scale rows near middle of body and 28 on caudal peduncle. Entire abdomen posterior to pelvic fins covered with embedded scales; half of abdomen anterior to pelvic fins with embedded scales. Tubed scale series complete or nearly complete on anterior half of body, absent or considerably interrupted on posterior half.

Coloration darker (dusky) than in *G. hanitschi*, without well-defined vertical bars on a relatively pale background; a continuous dark mid-lateral longitudinal band (absent in *G. hanitschi*). Fine melanophores extending from sides of body further toward and onto abdomen than in *G. hanitschi*. Nearly all scales with lozenge-shaped cluster of fine melanophores. Largest specimen, 52.4 mm female, uniformly dusky, without vertical bars or marks on dorsum or sides of body. Smallest specimen, 46.5 mm female, with about 20 vertical marks in side of body (less well defined, and lower lying than vertical bars in *G. hanitschi*); dorsum with 10 dark transverse marks anterior and 4 posterior to dorsal fin (absent in *G. hanitschi*). Specimen intermediate in size, a well-tuberculated 47.5 mm male, with markings on sides fewer and less well defined, but similar to those in smallest specimen, and marks on dorsum barely visible or absent.

Baleh and Tinjar *Glanioipsis*

MATERIAL EXAMINED.—FMNH 68137, 68151–68153, 69868, 24:20.4–38.0 mm, mainstream and tributaries of Baleh River. Rajang basin, Sarawak; BMNH 1933.8.9.9–10, 15:19.9–39.3 mm, Lejok River, altitude 50–1500 ft [ca. 15–460 m], Tinjar River District, Sarawak.

These specimens superficially resemble *G. hanitschi* but differ from it in their much smaller size, shorter barbels, having seven instead of only six branched dorsal-fin rays, fewer scales, and other minor differences.

Eye 24–32, 2.4–3.0 in interorbital width. Interorbital width 9.7–11.2. Depth caudal peduncle 8.9–10.0. Branched dorsal-fin rays invariably 7. Principal caudal rays usually 9+9. Pectoral-fin rays i12–i14; pelvic-fin rays i7 or i8. Adpressed nasal barbel extends posteriorly to middle of eye or almost to posterior border of exposed portion of eye. Upper and lower horny jaw sheaths moderately convex near symphysis.

Dorsum and sides of body completely covered with scales, or scales absent from dorsum only a short distance posterior to occiput; lateral

scale series with 102–115 scales, about 18–25 scale rows near middle of body, 22–24 on caudal peduncle. Abdomen between pelvic fins covered with scales, otherwise largely scaleless.

Dorsal and lateral surfaces of body mottled or with vertical or variably broken vertical bands of equal or variable width. Largest specimen, 39.3 mm, a gravid female.

Mulu *Glanioipsis*

MATERIAL EXAMINED.—BMNH uncat., 2:18.4–33.2 mm. Extreme headwater of Sungai Tapin [Baram basin], Gunong Mulu, Sarawak.

These two small specimens possibly represent an undescribed species. They differ from all other *Glanioipsis* examined in having a more slender body. Unlike *Glanioipsis* from Membikit, Baleh, and Tinjar, which seem closest to *G. hanitschi*, Mulu *Glanioipsis* perhaps is closest to *G. multiradiata*. It agrees with *G. multiradiata* in general appearance, color pattern, and in having relatively high paired-fin ray counts but differs in having longer barbels, smaller eyes, larger scales, less extensive squamation, and paired fins with slightly fewer rays, as well as a more slender body. Eye 30–31 (20–25 in 5 *G. multiradiata* 24.3–36.9 mm), 3.4–3.7 in interorbital space. Interorbital space 8.4–9.0. Body depth 9.5–9.7 (6.4–8.1 in *G. multiradiata*). Depth caudal peduncle 10.2–11.4. Branched dorsal-fin rays 7 (2). Branched anal-fin rays 5 (2). Principal caudal-fin rays 9+9 (2). Pectoral-fin rays i13 (1), i14 (1) (i15–17 in *G. multiradiata*). Pelvic-fin rays i8 (2) (usually i9 in *G. multiradiata*). Pelvic-fin origin closer to pectoral than to anal-fin origin (equidistant between pectoral and anal-fin origins or closer to anal-fin origin in *G. hanitschi* and *G. multiradiata*).

Length of nasal, rostral, maxillary and outer mandibular barbels equal to or greater than eye diameter. Adpressed nasal barbel reaches at least to middle of eye. Larger specimen, 33.2 mm, with mental barbels barbel-like. Smaller specimen, 18.4 mm, with unusually broad, thin lower lip and large flaps in position normally occupied by mental barbels. Lower lip interrupted by a median mental pad as in *G. multiradiata*.

Larger specimen with dorsum, abdomen, and ventral surface of body posterior to anal fin scaleless; lateral scale series nearly complete with about 100 scales, allowing for 4–5 scales

missing or having failed to develop slightly anterior to hypural fan (125–146 in *G. hanitschi*, 106–130 in *G. multiradiata*); at most 6–7 scale rows below and 5 above lateral scale series, or a maximum total of about 13 scale rows on side of body (vs. 25 or more in *G. hanitschi* and *G. multiradiata*); tubed scale series complete on anterior half of body, largely discontinuous or incomplete on posterior half. Smaller specimen entirely or almost entirely scaleless.

Larger specimen with dorsal and lateral surfaces of head and body dusky, on body mainly due to large lozenge- or scale-shaped clusters of melanophores overlying nearly every scale; dorsum anterior to dorsal fin with large mottles similar to those in *G. multiradiata*; cluster of melanophores lateral to pelvic-fin base; cluster of melanophores toward base of each caudal-fin lobe, fins otherwise without distinct markings. Smaller specimen with fine melanophores uniformly distributed over dorsal and lateral surfaces of head and body, and concentrations of melanophores along dorsal-fin base and lateral line canal, otherwise without distinct markings.

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